DATA REPORT

Wyckoff/Eagle Harbor
Evaluation of Sediment Cap Condition at East Harbor Operable Unit

Prepared for
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ACRONYMS AND ABBREVIATIONS

3D	3 dimensional
cy	cubic yard
DGPS	differential global positioning system
DMMP	Dredged Material Management Program
DNR	Washington State Department of Natural Resources
EPA	U.S. Environmental Protection Agency
EVS	Environmental Visualization System
GIS	geographic information system
GPS	global positioning system
NAD	North American Datum
PAH	polycyclic aromatic hydrocarbon
ROV	remotely operated vehicle
USACE	U.S. Army Corps of Engineers

1 INTRODUCTION

This data report summarizes the field investigation and presents the findings of the sediment cap evaluation conducted for EPA by Integral Consulting Inc. under its monitoring contract with the Washington State Department of Natural Resources (DNR).

1.1 BACKGROUND

The Wyckoff / Eagle Harbor Superfund site is located on Bainbridge Island, Washington (Figure 1-1). The East Harbor Operable Unit includes more than 70 acres of intertidal and subtidal habitats that were contaminated by releases of creosote and other wood-treating chemicals from the former Wyckoff wood-treating plant (DNR 2013). The primary sediment contaminants are polycyclic aromatic hydrocarbons (PAHs). In 1994–95, the U.S. Environmental Protection Agency (EPA) placed a cap of clean dredged sand over 50 acres of contaminated sediment in the harbor (Phase 1). The cap ranged from 2 to 5 ft thick. Additional subtidal capping took place in 2000 (Phase 2) and 2001 (Phase 3) (Figure 1-1; DNR 2013).

The cap has been monitored regularly since its construction (DNR 2013). The most recent monitoring, performed in 2011 (HDR et al. 2012), showed that most of the cap is physically stable and continues to protect benthic organisms and fish from exposure to PAHs in the buried sediment. However, the 2011monitoring report notes several areas where the Phase 1 cap material has either completely eroded or is too thin to provide adequate chemical isolation. One area is within the Washington State ferry lane, where sediment monitoring, erosion modeling, and measured bottom current velocities suggest that the currents generated by the ferry prop wash have eroded portions of the cap (DNR 2013). Another area is offshore of the former facility's West Dock, in an area of the site referred to as J9/J10, where the 2011 monitoring found contaminant concentrations just below the sediment surface exceeding the Washington State sediment quality standards (HDR et al. 2012). In the case of J9/J10, the area is on the margins of sequential past capping efforts, so there is some uncertainty as to whether this area initially received 3 ft of material during construction, or if some post-placement redistribution and/or slumping may have occurred.

EPA plans to patch the cap to isolate contaminated sediment and protect the newly capped areas as needed to prevent future erosion (DNR 2013). As manager of state-owned aquatic lands, the Washington State Department of Natural Resources (DNR) is coordinating with EPA and the U.S. Army Corps of Engineers (USACE), Seattle District, to conduct this investigation to map where and how much additional cap material is needed to be protective of state-owned lands.

The sand used to construct most of the original 50+ acre Phase I cap was dredged from state-owned aquatic lands in the Snohomish River as part of a Federal navigation maintenance project. DNR is a participating agency in the regional Dredged Material Management Program (DMMP) and coordinates regularly with the other DMMP agencies, EPA, USACE, and the Washington State Department of Ecology on dredging and beneficial reuse projects.

In support of the investigation goal stated above, specific objectives for this field effort were:

1. To collect measurements of cap thickness in the investigation areas so that the volume of material needed may be calculated
2. To refine the boundaries of where additional material is needed
3. To identify in the J9/J10 area where the cap material is not present.

1.2 APPROACH

The design of the overall investigation was to use a variety of technologies in a phased approach, and to adapt the approach of each subsequent phase based on the findings of the preceding phase. The four phases proposed in the work plan (Integral 2014; Appendix A) included the following:

1. Remotely operated vehicle (ROV) video survey (ROV provided and operated by EPA)
2. Down-hole video coring (or, videoprobing)
3. Sediment vibracoring
4. Subbottom profiling (this phase is contingent upon evaluation of the results from Phases 2 and 3).

The ROV video survey was conducted on October 30 and 31, 2013, and the results from this survey were presented in the work plan, which was finalized in February 2014 and is provided herein as Appendix A. The ROV results are not repeated here. The video-coring (videoprobing) and vibracoring surveys were conducted in March and April 2014 and are the subject of this data report. To date, no final decision has been made on the need to conduct the proposed subbottom profiling survey. However, based on the results presented here and pending agency team review, the technical objectives of the sampling program appear to have been met.

2 FIELD INVESTIGATION

This section presents a summary of the field investigation and methodology. Both the videoprobing and vibracoring surveys were conducted from the sampling vessel R/V *Nancy Anne* operated by Marine Sampling Systems, Burley, Washington.

The videoprobe survey began on March 5, 2014. Two stations were completed and the vessel was in the process of deploying the videoprobe on a third station when the tip of the probe frame caught on the edge of the vessel deck as the A-frame was being lifted. This caused overloading and failure of the lifting cable, which resulted in the videoprobe frame falling overboard and the probe being bent upon impact with the bottom. The survey was suspended until repairs could be made.

Following repair of the videoprobe, the videoprobe survey was resumed on April 15 and 16. The video data from the 43 stations completed though April 16 were reviewed and mapped, and a meeting was held with the agencies on April 21. At the meeting the team agreed that the videoprobe survey would be extended with four additional videoprobe stations added, and the locations of the six vibracores were adjusted based on the videoprobe data that had been acquired. These four additional videoprobe stations were surveyed the morning of April 22, and the vibracores were collected in the afternoon.

2.1 NAVIGATION

The target station coordinates provided in the work plan were entered into the sampling vessel's navigation system prior to collecting data at each station. The *Nancy Anne* was equipped with a Trimble AG132 differential global positioning system (DGPS) receiver and computer navigation software. The DGPS receiver was situated on the vessel's A-frame over the sampling gear to acquire the most accurate position for each location.

The vessel maneuvered to the target coordinate location (to within approximately 6 m, or 20 ft) for sampling. A positional fix was recorded when the corer reached the seafloor. Horizontal coordinates were recorded in the navigation system and in the field logbook as latitude and longitude (North American Datum [NAD] 83) to the nearest 0.1 second (i.e., 10^{-5} degree). A copy of the field logbook is provided in Appendix B.

One navigation check was performed at navigation light at marker 4 in Eagle Harbor to verify the accuracy of the GPS (Figure 2-1). The coordinates obtained from the *Nancy Anne* for this location were 47° 37.31905′ N, 122° 29.84626′ W. The published approximate[1] location for this

[1] Per USCG 2014, the published position is approximate, intended only to facilitate locating the aid on a navigation chart.

light is 47° 37′ 19.133″ N, 122° 29 50.640″ W (i.e., 47° 37.31888′ N, 122° 29.84400′ W; USCG 2014). These two coordinate sets are approximately 9 ft apart. This is 1 m more than the expected ±2 m accuracy; however, this discrepancy could be attributed to the fact that, as shown in Figure 2-1, the vessel was physically limited in how close it could get the GPS receiver to the marker light.

2.2 VIDEOPROBE SURVEY

A total of 47 locations were included in the video survey, representing 38 of the locations proposed in the work plan, 8 stations that were added in the field, and 1 station (Station 32) that was abandoned because it was located on a slope and the videoprobe frame tipped as the probe was descending through the sediment. Among these added stations were two locations where cap measurements were made using vibracores during the 2011 monitoring event (Stations F7 and I5). Twelve of the stations proposed in the work plan were not surveyed. Based on the results being acquired in the field, these stations were considered of lower priority in comparison to the stations that were added, primarily due to their proximity to other stations and the need for additional data on the edges of the proposed survey grid. Table 2-1 lists the stations, actual coordinates, cap thickness measurements, and notes from the videoprobe stations.

Two components of the videoprobe system described in the work plan were replaced in the field. Due to problems with clarity using the probe's sapphire-surfaced oval lens, this was replaced with a conical Plexiglas lens. Also, the magnetic counter used to provide depth information malfunctioned at the beginning of the April field effort. Instead, videoprobe depths were read off the vessel's depth profiler, which received data regarding the probe's depth of penetration from a fathometer mounted on the videoprobe head. Regardless of which depth measurement device was used, the depth readings were recorded as audio on the probe's videorecording; because the audio consisted primarily of these depth data recordings, no transcript of the audio portion of the video recording was made.

The probe was advanced through the sediment by gravity, or by vibrating the probe using a pneumatic vibrating system. The live videofeed from the probe's camera was displayed on a monitor in the vessel's wheelhouse and recorded on videotape. The videorecordings were later converted to digital format and are provided as an electronic appendix to this report (Appendix C). Each recording was immediately reviewed in the field, and the observed depth of the bottom of the cap deposit was recorded in the field logbook. A water depth measurement was made at each station using a handheld fathometer. This depth, the time of the measurement, and the station's actual coordinates were recorded in the field logbook.

2.3 VIBRACORING

As described in the work plan, the vibracorer uses a pneumatic system that vibrates and drives a length of 4-in. outer diameter aluminum tubing into the sediment. Marine Sampling System's vibracorer does not require a core liner. A continuous sediment sample is retained within the tubing with the aid of a stainless-steel core catcher.

At each vibracore station, the cores were driven to a depth of 7 ft below the sediment surface. At two locations, the recovered cores did not meet the work plan's sediment recovery objective of 80 percent of the driven core length; therefore, a second replicate was collected. In each case, the second replicate achieved the 80 percent recovery objective. All cores collected were retained for processing.

Once the core was onboard the sampling vessel, the overlying water was siphoned from the top of the core. Empty core tube at the top of each core was cut and removed so that the capped core tube was full of sediment which limits disturbance during storage and transport. No subsectioning of the cores was required for transport. The bottom 6 in. of the core tubes containing the core catcher was removed, and the core ends were covered with aluminum foil and a protective cap, which was sealed with duct tape to minimize leakage.

The cores were stored in the locked field van at the marina at the end of the day. Because no samples were to be collected for laboratory analysis, refrigerating the cores was not necessary. The cores were transported the following day to the Wyckoff property for processing and logging.

The core tubes were opened by placing each core on a core-cutting table and cutting along the long axis using a circular saw. The tube was then be rotated 180° and cut again. After each core was cut, the entire core tube was moved to a visqueen-covered table and opened. Each core was then photographed, and a description of the core recorded on a core log form. Core logs and photographs are provided in Appendix D. The core descriptions include the following information:

- Core penetration depth and recovery
- Physical soil description (i.e., soil classification, density/consistency, color)
- Odor (e.g., hydrogen sulfide, petroleum)
- Visual stratification
- Debris
- Evidence of biological activity (e.g., detritus, shells, tubes, bioturbation, live or dead organisms)
- Presence of oil sheen

- Identification of the presence or absence of a cap layer, and its vertical extent if present.

Identification of the cap material layer was made under the supervision of Dave Browning, the lead project geologist.

Table 2-2 presents the target and actual location coordinates, water depths, and cap thickness measurements from the 2014 vibracores.

2.4 DECONTAMINATION

Water and incidental sediment adhering to the videoprobe and core tubes, or spilled on the deck of the coring vessel, was rinsed into the surface waters at the collection site. If sediment contamination was obvious (e.g., a petroleum sheen is present), the sediment was containerized to be disposed of with the waste sediment from the vibracore processing. The tip of the probe was wiped with a paper towel. In a few instances minor residual nonaqueous phase liquid staining adhered to the lens, which was wiped off with isopropyl alcohol applied with a paper towel. After the alcohol evaporated the paper towels were disposed of as nonhazardous solid waste.

Decontamination of the core processing equipment and used core tubing was conducted at the decontamination facility at the Wyckoff property. All nondisposable components of the core processing equipment that contacted the sediment was decontaminated using a freshwater rinse, followed by a wash using a detergent solution of Simple Green, and followed by a final freshwater rinse.

2.5 INVESTIGATION-DERIVED WASTE DISPOSAL

Investigation-derived waste materials included disposable field supplies (such as nitrile gloves, used aluminum foil, paper towels, etc.), excess sediment, and waste decontamination fluids. Disposable field supplies and personal protective equipment, washed or brushed free of excess sediment, were contained in plastic trash bags and disposed of through the Wyckoff facility. Decontaminated waste aluminum core tubing was submitted for recycling. Excess sediment from vibracore processing was placed on the waste soil stockpile at the Wyckoff facility. Coring waste decontamination fluids (detergent solution and rinse waters) was disposed through the Wyckoff facility wastewater treatment plant.

3 DATA COMPILATION AND MAPPING

This section describes the data compilation and mapping of the results for this investigation.

3.1 CAP THICKNESS DATA SETS

The available data sets of cap thickness measurements from 2014 and 2011 were combined and are presented in Figure 3-1. The mapped data include 75 measurements from the 46 videoprobes and 8 vibracores collected for this investigation, as well as those from 21 vibracores collected during the 2011 monitoring event (Table 3-1). As shown, most of the data are located in the area of the ferry lane and the J9/J10 area.

3.1.1 Observations

As noted in Tables 2-1 and 2-2, in addition to cap thicknesses, observations from the 2014 videoprobe and vibracore data included:

- Reworking of cap material deposits near the ferry terminal (Stations 6, 7, and 9)
- The presence of recent surface deposits on top of the cap layer at Stations 22 and 53 near the ferry path and at Stations 37, 45, 53, 56, 57, and 58 near the J9/J10 area, possibly due to slumping from the nearby slope
- Surface deposits of apparent mixed origin near the ferry terminal and along the ferry path (Stations 1, 3, 4, 16, 30, and 53) and in the J9/J10 area (Station 38)
- Layering of cap material in Phase 3 area (Stations 34, 35, 36, and 37).

3.1.2 Comparison of Co-located Results

Eight stations had one or more replicates among the data sets. Table 3-2 presents the replicates, the distances between them, and the differences in cap thickness measurements.

Overall, differences among the replicates ranged from zero (the two videoprobes at Station 45) to 1.25 ft (the videoprobe and vibracore at Station 7). Videoprobe and vibracore data showed agreement within 0.1 ft at one station (Station 22). The videoprobes showed thicker cap deposits than the vibracores at five stations (Stations 7, 37, 45, 53, and F7), and thinner cap deposits at two stations (Stations 26 and I5).

Videoprobes were collected at the 2011 vibracore stations F7 and I5. Differences between the 2014 videoprobes and the 2011 vibracores were 0.4 ft at F7, with the videoprobe showing a thicker cap layer than the historical vibracore, and 0.9 ft at I5, with the videoprobe showing a thinner cap layer than the vibracore. These differences are within the range of 0 to 1.25 ft shown by the contemporaneous 2014 videoprobe and vibracore measurement comparisons (Table 3-2).

The differences between station replicates may be due to real field heterogeneity, or compaction of the finer fractions in the cap material deposits during vibracoring. Figure 3-2 shows the relationship between the cap thickness estimates from the videprobe versus the vibracore at co-located stations. While some actual small-scale heterogeneity may be present, the general trend of thinner estimates from the cores relative to the probe suggests that there is some compaction in the vibracore samples.

3.2 MODELING

The methodology for determining the required volume and distribution of additional cap material is described in this section. The approach involved three steps:

1. Develop an input data file that contains the bathymetric elevation as the current cap thickness and a target cap thickness (3-ft, 2-ft, and 1.5-ft scenarios) for each sample location (n=75).
2. Develop a geostatistical volumetric 3 dimensional (3D) model by interpolating two surfaces that represent current conditions and conditions if a target cap thickness were present, based on the input data file.
3. Calculate volume estimates for three different target cap thickness by six individual subareas.

The methodology for each of these steps is summarized in the following subsections.

3.2.1 Current Conditions

The geostatistical modeling began with developing a 3D model representing current conditions using Environmental Visualization System (EVS)-Pro software.[2]

The model of current conditions required elevation data from each of the cap measurement points. The approach stated in the work plan for establishing vertical control for the 2014 survey stations was to reference water elevations recorded during the time of the survey at the National Oceanic and Atmospheric Administration tide station (ID #9447130) located on the downtown Seattle waterfront, or another appropriate nearby station. However, the tidal signal in Eagle Harbor has offsets of 4–5 minutes and 1–1.02 ft from conditions at the Seattle station,

[2] EVS-Pro software was developed by C Tech Development Corporation and is verified by the U.S. Environmental Protection Agency's Environmental Technology Verification Program.

and the time-series data for the predicted tidal curve available[3] for the Eagle Harbor tide station (ID #9445882) is not published (NOAA 2014; Kent 2014, pers. comm.). For these reasons, the 2009 NOAA bathymetric 1-m grid was considered to be preferable and was used as the source for current station surface elevations, with the assumption that the bathymetry in the area hasn't changed significantly since the 2009 survey was performed.

The data representing current conditions at each survey point is summarized in Table 3-3.[4] A surface was created from the bathymetric elevation data that represents current cap thickness by 3-dimensional geologic kriging using the EVS-Pro Krig 3-D Geology module.

3.2.2 Target Cap Thickness Elevations

As requested by EPA, three target cap thicknesses scenarios were considered: 1.5 ft, 2 ft, and 3 ft. To build model surfaces representing bathymetric conditions if each target thickness were present, the difference in the current cap thickness and the target cap thickness (i.e., additional cap needed) was calculated for each cap measurement location. Where current cap thicknesses already exceed the target thickness, values of zero were assigned, indicating no additional cap thickness is needed. Target elevations representing the bathymetric conditions if each target thickness were present were then calculated using the thickness difference values (Table 3-4). As described above for the current elevations, surfaces were created from each of the target elevations.

3.2.3 Difference Models and Calculated Volumes

For each target cap thickness, the current and target cap elevation point values (Table 3-4) were input into a two-surface EVS geology file (*.geo). Using this geology file, current and target surfaces were generated in the Krig 3D Geology module. A volumetric model was rendered from the comparison between the target and current surfaces.

These three volumetric models, shown in Figures 3-3, 3-4, and 3-5, were the basis for estimates of additional cap material volume needed for each target cap thickness. In these figures, areas where the current thickness is equal to the target thickness show needed values of 0 ft, and inversely, areas where current cap thickness is 0 ft show needed values equal to the target thickness.

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3 http://tidesandcurrents.noaa.gov/noaatidepredictions/viewDailyPredictions.jsp?bmon=04&bday=15&byear=2014&timelength=daily&timeZone=2&dataUnits=1&datum=MLLW&timeUnits=2&interval=highlow&format=Submit&Stationid=9445882

4 Note that Station J9d was located beyond the extent of the 2009 NOAA bathymetry; the elevation value for this station was extrapolated from a nearby value.

The focus of this investigation was the ferry lane and the immediately adjoining areas where long-term cap monitoring has shown that the cap integrity is compromised, and in the J9/J10 area where information regarding cap thickness had been needed. Because most of the data were located in these two areas rather than being equally distributed across the site, the final comprehensive volumetric model was subset (masked) into six subareas and individual volumes were calculated. The estimated volumes of additional cap material needed per subarea are shown on Figures 3-3, 3-4, and 3-5 and listed in Table 3-5. A tally of the number of data points that fall within each subarea is shown in Table 3-6. All data is used in the Krig interpolation therefore data points not included in a subarea (n=23) still have influence on thickness estimates to subareas with close proximity. The average sample spacing value for each subarea is also included in Table 3-6. The lower the spacing values the stronger degree of thickness characterization within each subarea.

As shown, the estimated volume of material needed in the ferry lane (Area 3), well-defined by the data collected in 2014, is 8,400 cy for a 1.5-ft cap, 17,000 cy for a 2-ft cap, and 39,000 cy for a 3-ft cap. With the potential exception of the J9/J10 area, the other portions of the Eagle Harbor cap appear to be effective in isolating subsurface contamination from human and ecological receptors of concern and there is no indication that additional cap material is needed (HDR et al. 2012).

4 REFERENCES

DNR. 2013. PSC 11-107, Modified Task Order #5, September 26, 2013, Eagle Harbor Sediment Cap Condition/Erosion. Submitted to Integral Consulting Inc., Olympia, WA. Washington State Department of Natural Resources, Olympia, WA.

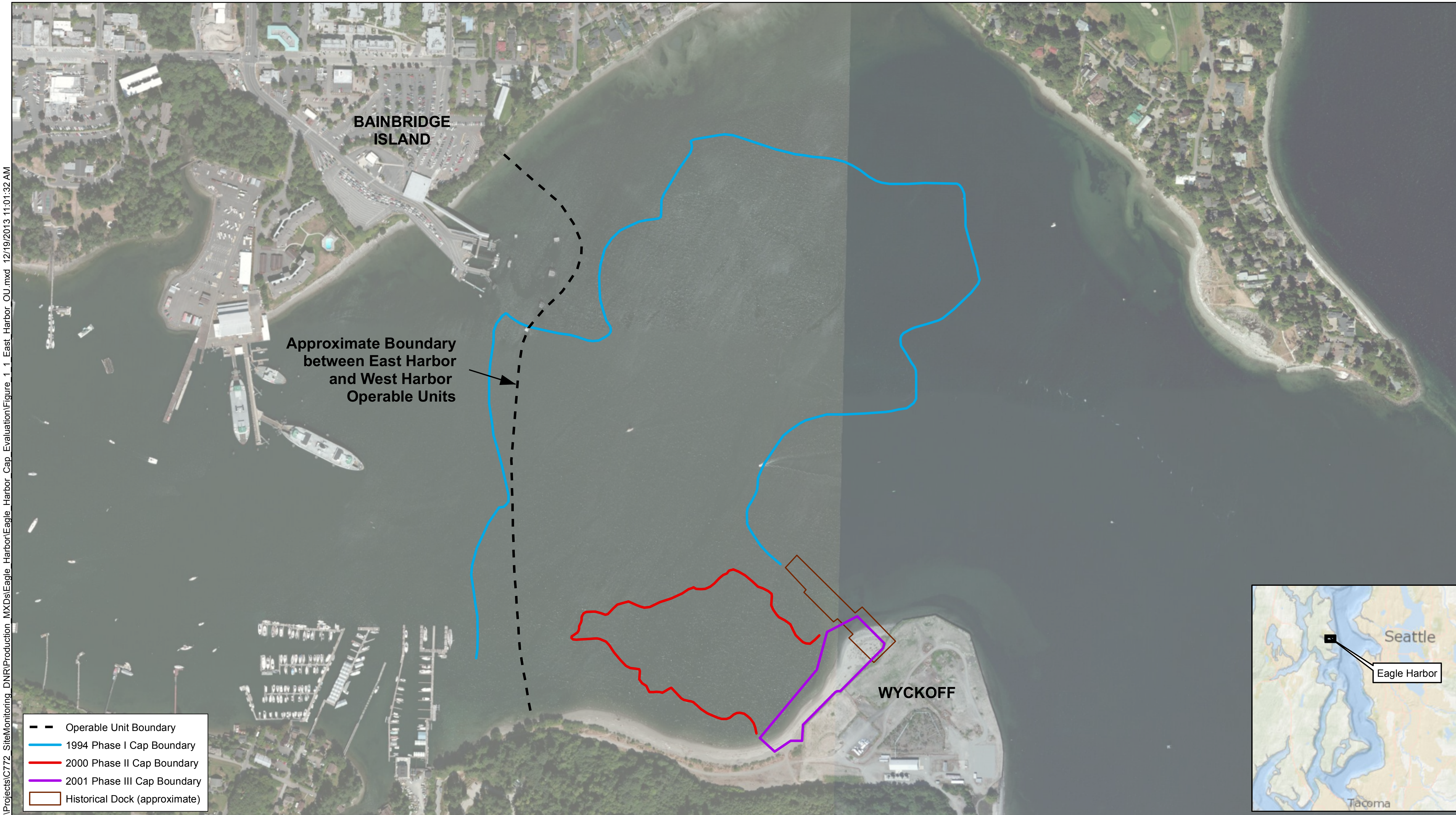
HDR, SEE, and KTA. 2012. 2011 Year 17 Monitoring Report, East Harbor Operable Unit, Wyckoff/Eagle Harbor Superfund Site. Prepared for U.S. Environmental Protection Agency Region 10, and U.S. Army Corps of Engineers Seattle District. Prepared by HDR Engineering, Inc., Olympia, WA, Science and Engineering for the Environment, LLC, Seattle, WA, and Ken Taylor Associates, Inc., Seattle, WA. September 7, 2012.

Kent, J. 2014. Personal communication (e-mail to S. FitzGerald, Integral Consulting Inc., regarding tide predictions for Eagle Harbor, Bainbridge Island, WA (Station ID: 9445882)). J. Kent, Oceanographer, User Services, Center for Operational Oceanographic Products and Services. April 25, 2014.

NOAA. 2014. Eagle Harbor, Bainbridge Island, 9445882 Tidal Data Daily View, available at: http://tidesandcurrents.noaa.gov/noaatidepredictions/viewDailyPredictions.jsp?bmon=04&bday=15&byear=2014&timelength=daily&timeZone=2&dataUnits=1&datum=MLLW&timeUnits=2&interval=highlow&format=Submit&Stationid=9445882. Accessed April 25, 2014.

USCG. 2014. Light List, Volume 6, Pacific Coast and Pacific Islands. Corrected through Local Notice to Mariners (LNM) week: 53/13. United States Coast Guard, United States Department of Homeland Security. COMDTPUB P16502.6. 315 pp.

FIGURES



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0 300 600
Feet

N
16° 45'
Magnetic
North

Figure 1-1.
East Harbor Operable Unit and Sediment Cap Locations,
Wyckoff/Eagle Harbor Facility

Figure 2-1
Navigation Check

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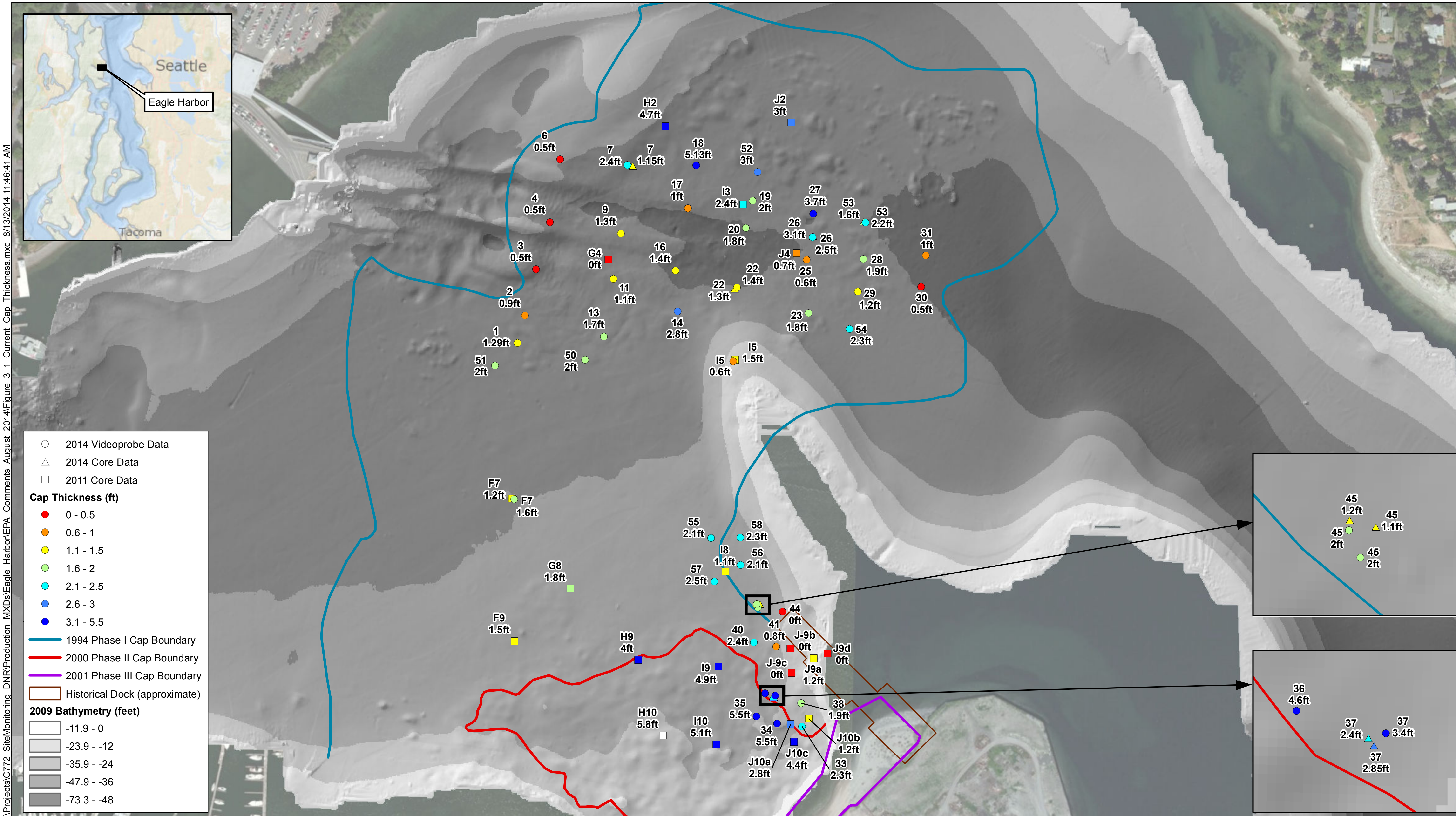

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0 300 600
Feet

N
16° 45'
Magnetic
North

Note:
M = Magnetic North (16° 45')

Figure 3-1.
Cap Thickness Data

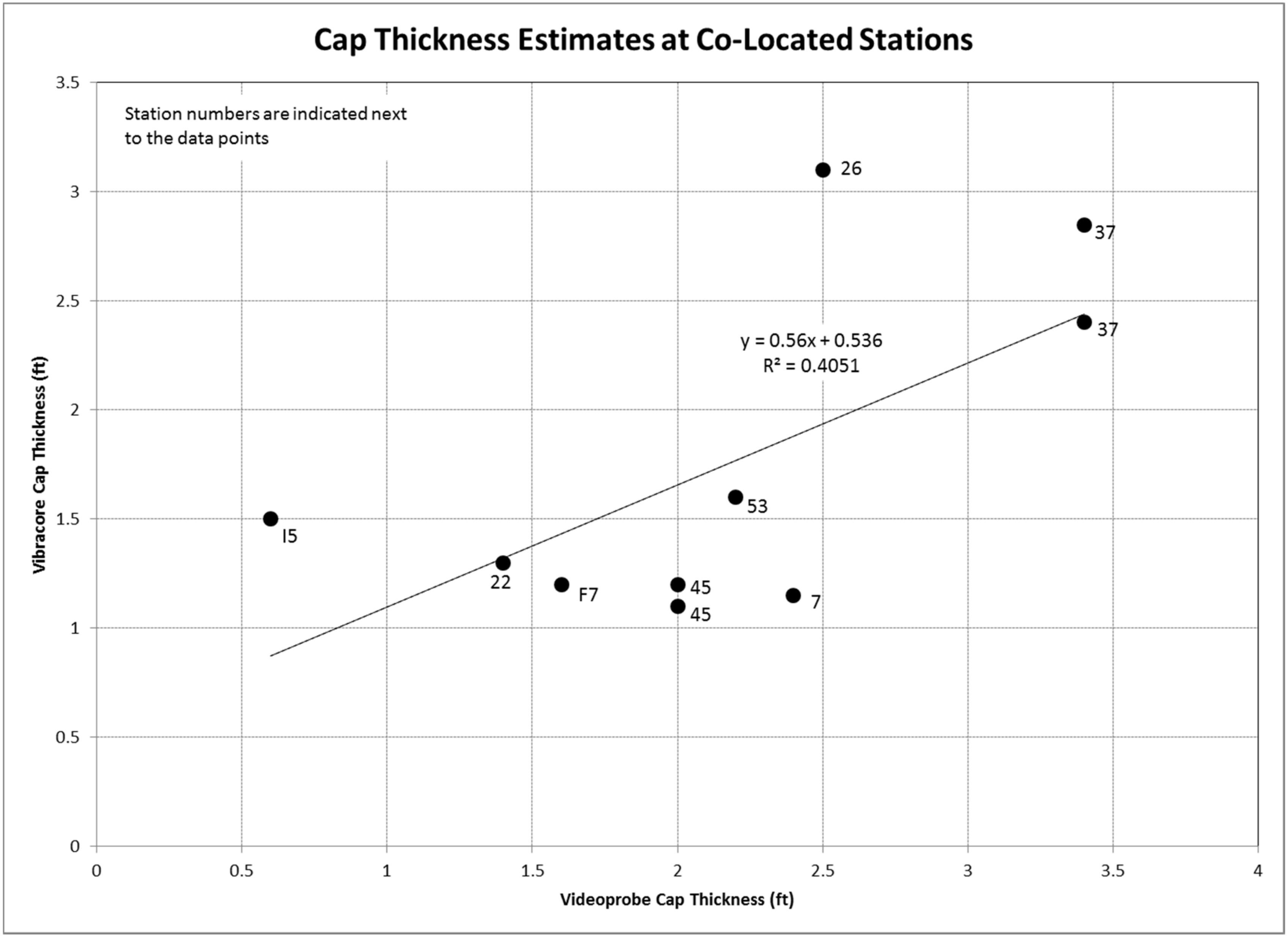

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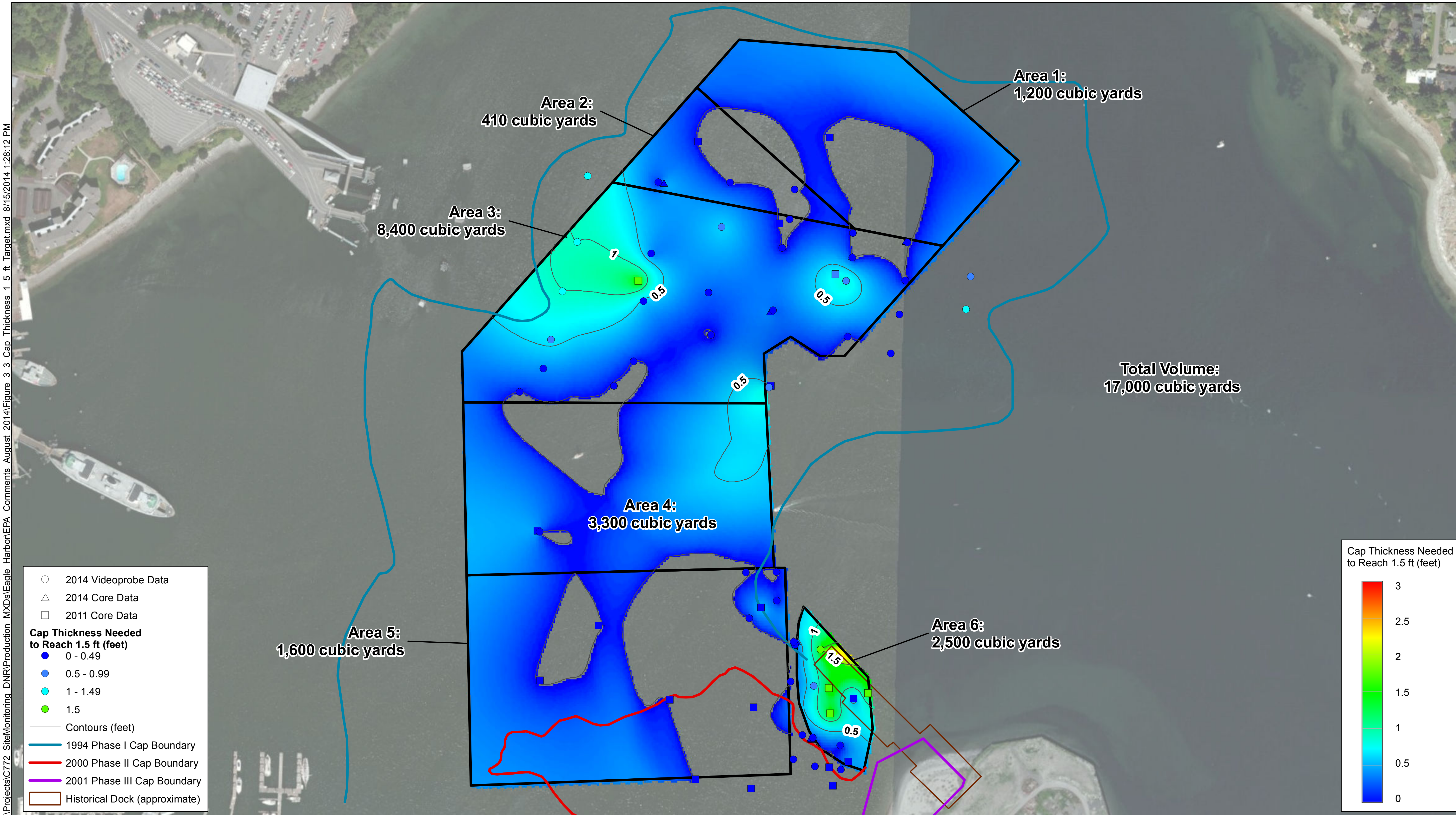
Figure 3-2
Scatterplot of Cap Thickness Estimates at Co-Located Stations



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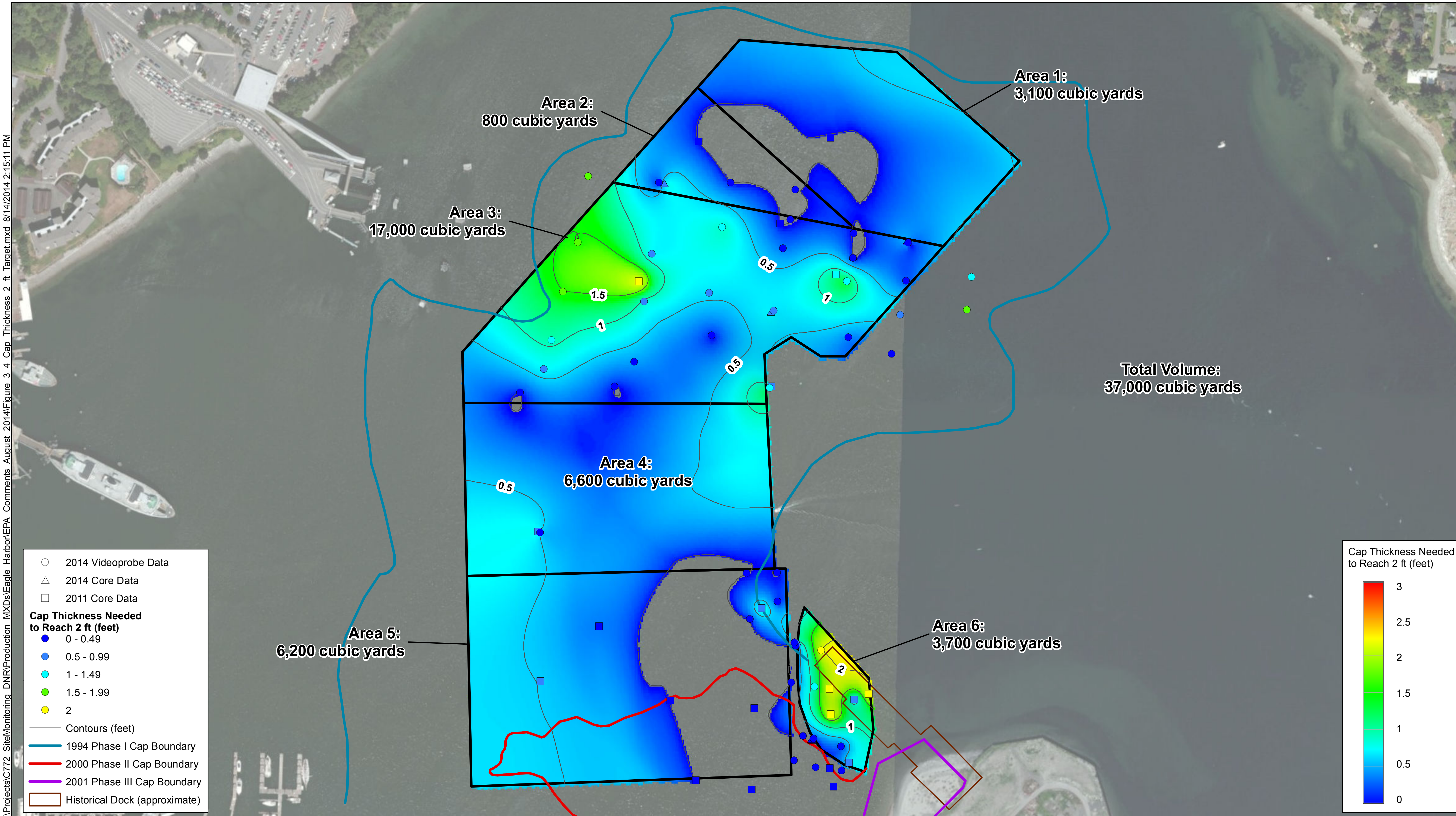
0 200 400
Feet

N
16° 45'
Magnetic
North

Note:
M = Magnetic North (16° 45')

Figure 3-3.
Thickness and Volumes of Cap Material Needed
for 1.5-ft Target Cap Thickness



integral consulting inc.

0 200 400
Feet

N
16° 45'
Magnetic
North

Note:
M = Magnetic North (16° 45')

Figure 3-4.
Thickness and Volumes of Cap Material Needed
for 2-ft Target Cap Thickness

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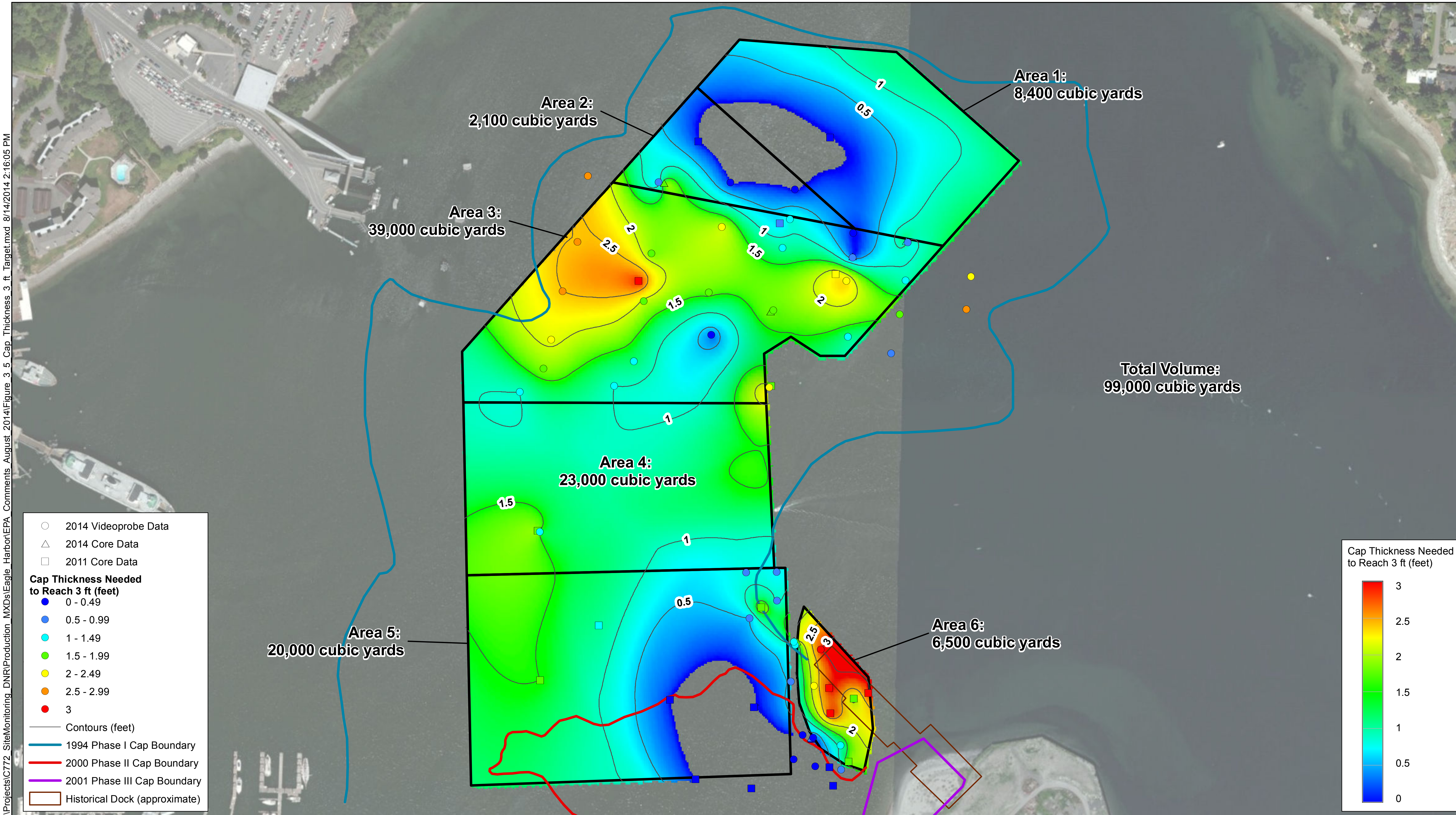

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0 200 400
Feet

N
16° 45'
Magnetic
North

Note:
M = Magnetic North (16° 45')

Figure 3-5.
Thickness and Volumes of Cap Material Needed for 3-ft Target Cap Thickness

TABLES

Table 2-1. Summary of 2014 Videoprobe Data

Transect Number	Station Number	Videoprobe ID	Date	Target Latitude	Target Longitude	Actual Latitude	Actual Longitude	Depth Time	Water Depth (ft)	Cap Thickness (ft)	Notes
T1	51	51-VP1	15-Apr-2014	--	--	47 37.24239	122 30.45131	16:05	46.6	2	Revised cap estimate from "2 - 2.2" to 2 ft during video review.
	1	01-VP2	5-Mar-2014	47.62091	-122.50722	47 37.25462	122 30.43396	14:52	44.7	1.29	Replicate 2 at this station. Surface layer looked like a mix, not pure cap material. Water depth recorded on April 15.
	2	02-VP1	15-Apr-2014	47.62112	-122.50715	47 37.26945	122 30.42859	14:58	46.4	0.9	Revised from "0.9 - 1.1" to 0.9' during video review.
	3	03-VP1	16-Apr-2014	47.62159	-122.50699	47 37.29420	122 30.42075	10:57	41.1	0.5	Washed shell hash at surface. Revised cap estimate from "0.0" to 0.5 ft during review; mixed loose well sorted over native or mixed native.
	4	04-VP1	16-Apr-2014	47.62200	-122.50685	47 37.31955	122 30.41044	10:45	40.3	0.5	Hard substrate, top foot is mixed material. Revised cap estimate from "0.9" to 0.5 ft during video review; mixed loose well sorted over native or mixed native.
	5	--	--	47.62224	-122.50676	--	--	--	--	--	Not surveyed.
	6	06-VP1	15-Apr-2014	47.62243	-122.50670	47 37.35321	122 30.40368	14:13	37.2 ft	0.5	Revised cap estimate from '"0.8 - 1.1" field estimate to 0.5 during review; top 0.3 ft is reworked material. Hard native below, with gravels.
T2	**7**	07-VP2	15-Apr-2014	47.62251	-122.50582	**47 37.35080**	**122 30.35041**	14:24	41.8	2.4	Replicate 2 at this station. Cap material has been reworked.
	8		--	47.62225	-122.50587	--	--	--	--	--	Not surveyed.
	9	09-VP1	16-Apr-2014	47.62202	-122.50592	47 37.31432	122 30.35452	10:34	45.0	1.3	Appears mixed. Top foot of cap is reworked.
	10	--	--	47.62161	-122.50599	--	--	--	--	--	Not surveyed.
	11	11-VP1	16-Apr-2014	47.62142	-122.50603	47 37.29009	122 30.35958	10:01	48.6	1.1	
	12	--	--	47.62124	-122.50606	--	--	--	--	--	Not surveyed.
	13	13-VP2	15-Apr-2014	47.62100	-122.50610	47 37.25922	122 30.3660	10:21	43.8	1.7	Replicate 2 at this station. End depth 5.6 ft bml.
	50	50-VP1	15-Apr-2014	--	--	47 37.24665	122 30.38038	15:54	47.8	2	Revised from "2 to 2.2" to 2 ft during video review.
T3	14	14-VP1	15-Apr-2014	47.62120	-122.50522	47 37.27350	122 30.30826	11:15	46.1	2.8	Revised from "2.7 to 2.8" to 2.8 ft during video review.
	15	--	--	47.62138	-122.50518	--	--	--	--	--	Not surveyed.
	16	16-VP1	15-Apr-2014	47.62155	-122.50515	47 37.29513	122 30.31082	11:37	48.8	1.4	Revised from 1.4 - 1.5 to 1.4 ft during video review; 0.2 ft mixed layer at bottom of cap layer. Bottom of cap is mix with native materials.
	17	17-VP1	15-Apr-2014	47.62215	-122.50502	47 37.32861	122 30.30207	11:46	45.4	1	Revised from "0.5 to 1" to 1 ft during video review.
	18	18-VP1	5-Mar-2014	47.62253	-122.50493	47 37.35144	122 30.29624	14:49	48.8 ft	5.13	Probe started w/counter at 61, cap material at surface; native encountered at 149. Water level recorded on April 15.
T4	52	52-VP1	16-Apr-2014	--	--	47 37.34855	122 30.24768	13:45	44.9 ft	3	Revised from "2.8 - 3.1" field estimate to 3 ft during video review.
	19	19-VP1	15-Apr-2014	47.62222	-122.50421	47 37.33328	122 30.25100	10:36	46.8 ft	2	End depth 5.5; cap thickness revised to 2 ft during video review.
	20	20-VP1	16-Apr-2014	47.62197	-122.50426	47 37.31864	122 30.25591	10:13	50.5	1.8	
	21	--	--	47.62163	-122.50434	--	--	--	--	--	Not surveyed.
	22	22-VP1	15-Apr-2014	47.62145	-122.50438	**47 37.28683**	**122 30.26196**	15:36	54.4 ft	1.4	
T5	23	23-VP1	15-Apr-2014	47.62122	-122.50350	47 37.27410	122 30.20522	11:25	42.6 ft	1.8	
	24	--	--	47.62146	-122.50347	--	--	--	--	--	Not surveyed.
	25	25-VP1	15-Apr-2014	47.62170	-122.50344	47 37.30251	122 30.20749	12:12	47.4 ft	0.6	Revised cap estimate to 0.6 ft during video review.
	26	26-VP1	16-Apr-2014	47.62192	-122.50341	**47 37.31450**	**122 30.20316**	14:25	48.1	2.5	Recommended core location.
	27	27-VP1	15-Apr-2014	47.62213	-122.50339	47 37.32708	122 30.20312	12:02	45.7 ft	3.7	Revised cap estimate to 3.7 ft during video review.
	53	53-VP1	16-Apr-2014	--	--	**47 37.32280**	**122 30.16171**	14:15	49.0	2.2	Revised field estimate from 1.9 to 2.2 ft during video review. Cap material to 1.9, then 1.9 to 2.2 is mixed layer. Good location for a core.
T6	28	28-VP1	15-Apr-2014	47.62171	-122.50268	47 37.30349	122 30.16276	13:18	47.3 ft	1.9	Revised cap estimate from "2 ft" to 1.9 during video review.
	29	29-VP1	15-Apr-2014	47.62140	-122.50273	47 37.28609	122 30.16660	13:02	46.0 ft	1.2	Revised cap estimate from "1.3" to 1.2 during video review.
	54	54-VP1	16-Apr-2014	--	--	47 37.26610	122 30.17250	15:38	47.2	2.3	Revised cap estimate from "2.4" field estimate to 2.3 ft during video review.

Table 2-1. Summary of 2014 Videoprobe Data

Transect Number	Station Number	Videoprobe ID	Date	Target Latitude	Target Longitude	Actual Latitude	Actual Longitude	Depth Time	Water Depth (ft)	Cap Thickness (ft)	Notes
T7	31	31-VP1	15-Apr-2014	47.62177	-122.50188	47 37.30616	122 30.11368	15:22	54 ft est	1	Revised cap estimate from "0.9 ft" to 1.0 ft during review. Video shows apparent gas pocket in native sediment.
	30	30-VP1	15-Apr-2014	47.62148	-122.50190	47 37.28936	122 30.11666	15:09	52.8 ft	0.5	Revised cap estimate from "0.5 - 1.0" to 0.5 ft during video review. Soft sediment, mixed cap.
T8	32	abandoned	16-Apr-2014	47.61748	-122.50306	--	--	--	--	--	Abandoned station, no penetration at several locations, only slight penetration at one location, uneven surface, frame tipped over.
	33	33-VP1	16-Apr-2014	47.61753	-122.50338	47 37.05355	122 30.20326	9:31	26.9	2.3	Mixed material at surface.
	34	34-VP1	16-Apr-2014	47.61757	-122.50370	47 37.05490	122 30.22296	9:20	27.8 ft	5.5	Coarse sand; all cap, shows cap material layers.
	35	35-VP1	16-Apr-2014	47.61761	-122.50399	47 37.05838	122 30.23935	9:14	29.3 ft	5.5	Coarse sand, shows cap material layers.
T9	36	36-VP1	16-Apr-2014	47.61783	-122.50390	47 37.07087	122 30.23297	12:01	26.0	4.6	Revised cap estimate from "3.4" (which is bottom of Phase 2 cap) to 4.6 ft (bottom of Phase I cap) during video review.
	37	37-VP1	16-Apr-2014	47.61782	-122.50375	**47 37.06962**	**122 30.22493**	12:12	24.6	3.4	Revised cap estimate from "1.5" ft field estimate to 1.6 ft for bottom of Phase 2 cap and 3.4 for bottom of Phase I cap during video review.
	38	38-VP1	16-Apr-2014	47.61779	-122.50344	47 37.06597	122 30.20418	12:23	19.0	1.9	Revised cap estimate from "0" to 1.4 ft of mixed native and cap, above a 0.5 mixed layer, for a total of 1.9 ft cap material layer, during video review.
	39	--	--	47.61776	-122.50310					--	Not surveyed; in pilings.
T10	40	40-VP1	16-Apr-2014	47.61828	-122.50411	47 37.09784	122 30.24256	11:34	31.5	2.4	
	41	41-VP1	16-Apr-2014	47.61825	-122.50373	47 37.09592	122 30.22506	11:44	24.3	0.8	Revised cap estimate from "2.1" to 0.8 ft during review. Surface 0.8 ft composed of Phase I cap and recent deposition, mixed.
	42	--	--	47.61822	-122.50339	--	--	--	--	--	Not surveyed; in pilings.
T11	43	--	--	47.61856	-122.50333	--	--	--	--	--	Not surveyed.
	44	44-VP2	16-Apr-2014	47.61858	-122.50363	47 37.11458	122 30.22053	15:13	28.0	0	Replicate 2 at this location. Frame tipped over on first replicate try.
	45	45-VP1	16-Apr-2014	47.61860	-122.50399	**47 37.11658**	**122 30.23990**	14:41	35.2	2	1.9 to 2 ft of Phase I observed during video review.
	45	45-VP2	16-Apr-2014	47.61860	-122.50399	47 37.11816	122 30.24094	14:51	35.7	2	
T12	46	--	--	47.62252	-122.50754	--	--	--	--	--	Not surveyed.
	47	--	--	47.62228	-122.50761	--	--	--	--	--	Not surveyed.
	48	--	--	47.62154	-122.50782	--	--	--	--	--	Not surveyed.
	49	--	--	47.62132	-122.50789	--	--	--	--	--	Not surveyed.
	F7	F7-VP1	16-Apr-2014	47 37.1718	-122 30.4357	47 37.17143	122 30.43407	13:21	35.2	1.6	
	I5	I5-VP1	16-Apr-2014	47 37.2483	-122 30.2623	47 37.24754	122 30.26358	16:02	26.3	0.6	
	55	55-VP1	22-Apr-2014	NA	NA	47 37.15294	122 30.27806	9:30	42.3	2.1	
	56	56-VP1	22-Apr-2014	NA	NA	47 37.13902	122 30.25445	9:38	42.6	2.1	Recent sedimentation observed on top of cap material.
	57	57-VP1	22-Apr-2014	NA	NA	47 37.12981	122 30.27473	9:47	41.7	2.5	Recent sedimentation observed on top of cap material.
	58	58-VP1	22-Apr-2014	NA	NA	47 37.15364	122 30.25515	10:01	39.5	2.3	Recent sedimentation observed on top of cap material.

Notes:
Shaded cells denote stations added in the field.
Bold text denotes videoprobe stations selected for vibracore collection.

Table 2-2. Location Information and Cap Thickness Measurements from 2014 Vibracores

Station Number	Vibracore ID	Date	Target Latitude	Target Longitude	Actual Latitude	Actual Longitude	Depth Time	Water Depth (ft)	Cap Thickness (ft)	Notes
7	07-VC1	22-Apr-2014	47 37.35080	122 30.35041	47.62251	-122.50577	14:22	46.3	1.15	0.5 ft reworked Phase I material on top of Phase I deposit.
22	22-VC1	22-Apr-2014	47 37.28683	122 30.26196	47.62144	-122.50440	12:36	55.3	1.3	0.4 ft recent deposition on top of Phase I deposit.
26	26-VC1	22-Apr-2014	47 37.31450	122 30.20316	47.62192	-122.50339	13:19	52.5	3.1	--
37	37-VC1	22-Apr-2014	47 37.06962	122 30.22493	47.61782	-122.50378	12:11	33.8	2.4	0.15 ft recent deposition on top of Phase I deposit.
37	37-VC2	22-Apr-2014	47 37.06962	122 30.22493	47.61781	-122.50377	15:12	28.6	2.85	0.25 ft recent deposition on top of Phase I deposit.
45	45-VC1	22-Apr-2014	47 37.11658	122 30.23990	47.61865	-122.50402	14:49	36.2	1.2	0.5 ft recent deposition on top of Phase I deposit.
45	45-VC2	22-Apr-2014	47 37.11658	122 30.23990	47.61864	-122.50398	15:38	34.2	1.1	0.6 ft recent deposition on top of Phase I deposit.
53	53-VC1	22-Apr-2014	47 37.32280	122 30.16171	47.62206	-122.50272	13:44	53.3	1.6	0.3 ft recent deposition on top of Phase I deposit.

Table 3-1. Cap Thickness Measurements from 2011 Vibracores

Station Number	Actual Latitude	Actual Longitude	Cap Thickness (ft)
F-7	47.61953	-122.50726	1.2
F-9	47.61826	-122.50719	1.5
G-4	47.62167	-122.50607	0
G-8	47.61874	-122.50647	1.8
H-10	47.61745	-122.50521	5.8
H-2	47.62287	-122.50535	4.7
H-9	47.61812	-122.50556	4
I-10	47.61738	-122.50451	5.1
I-3	47.62219	-122.50431	2.4
I-5	47.62081	-122.50437	1.5
I-8	47.61892	-122.50444	1.1
I-9	47.61808	-122.50450	4.9
J-10a	47.61758	-122.50354	2.8
J-10b	47.61763	-122.50330	1.2
J-10c	47.61742	-122.50349	4.4
J-2	47.62292	-122.50370	3
J-4	47.62177	-122.50359	0.7
J-9a	47.61817	-122.50325	1.2
J-9b	47.61825	-122.50356	0
J-9c	47.61804	-122.50354	0
J-9d	47.61822	-122.50307	0

Note: J9a value is from core 2. Core 1 value is shown in HDR et al. (2012) as 0.9, but no coordinate was found for core 1.

Table 3-2. Station Replicate Comparisons

Station	Distance Between Replicates	ID	Date	Actual Latitude	Actual Longitude	Cap Thickness (ft)	Notes
7	17.38	07-VP2	15-Apr-2014	47.61953	-122.50726	2.4	Videoprobe shows thicker cap than vibracore.
		07-VC1	22-Apr-2014	47.62251	-122.50577	1.15	
22	9.6	22-VP1	15-Apr-2014	47.62145	-122.50437	1.4	Videoprobe agrees with vibracore.
		22-VC1	22-Apr-2014	47.62144	-122.50440	1.3	
26	3.77	26-VP1	16-Apr-2014	47.62191	-122.50339	2.5	Videoprobe shows thinner cap than vibracore.
		26-VC1	22-Apr-2014	47.62192	-122.50339	3.1	
37		37-VP1	16-Apr-2014	47.61783	-122.50375	3.4	Videoprobe shows thicker cap than vibracores
	6.76	37-VC1	22-Apr-2014	47.61782	-122.50378	2.4	These two vibracores differed by 0.45 feet, both showed thinner cap layer than videoprobe.
	6.35	37-VC2	22-Apr-2014	47.61781	-122.50377	2.85	
45		45-VP1	16-Apr-2014	47.61861	-122.50400	2	Videoprobe shows thicker cap than vibracore.
	10.51	45-VP2	16-Apr-2014	47.61864	-122.50402	2	Two videoprobes in agreement with each other, the two vibracores in agreement with each other.
	13.95	45-VC1	22-Apr-2014	47.61865	-122.50402	1.2	
	12.29	45-VC2	22-Apr-2014	47.61864	-122.50398	1.1	
53	7.39	53-VP1	16-Apr-2014	47.62205	-122.50270	2.2	Videoprobe shows thicker cap than vibracore.
		53-VC1	22-Apr-2014	47.62206	-122.50272	1.6	
F7	7.07	F7-VP1	16-Apr-2014	47.61952	-122.50723	1.6	Videoprobe shows thicker cap than vibracore.
		F-7	10-Oct-2011	47.61953	-122.50726	1.2	
I5	7	I5-VP1	16-Apr-2014	47.62079	-122.50439	0.6	Videoprobe shows thinner cap than vibracore.
		I-5	11-Oct-2011	47.62081	-122.50437	1.5	

Notes:
Shaded cells indicate vibracore data.

Table 3-3. Current Station Elevations and Cap Thicknesses

Station Number	ID	Type	Latitude (degrees)	Longitude (degrees)	X[a] (ft)	Y[a] (ft)	Cap Thickness (ft)	Elevation (ft)[b]
1	01-VP2	2014 Videoprobe Data	47.62091	-122.507233	1227637.9	230978.5	1.29	-40.76
2	02-VP1	2014 Videoprobe Data	47.621158	-122.507143	1227661.9	231068.2	0.9	-41.73
3	03-VP1	2014 Videoprobe Data	47.62157	-122.507013	1227697.4	231217.9	0.5	-40.47
4	04-VP1	2014 Videoprobe Data	47.621992	-122.506841	1227743.1	231371.1	0.5	-39.17
6	06-VP1	2014 Videoprobe Data	47.622554	-122.506728	1227775.3	231575.1	0.5	-35.32
7	07-VC1	2014 Core Data	47.622507	-122.50577	1228011.1	231553.0	1.15	-41.89
7	07-VP2	2014 Videoprobe Data	47.622513	-122.50584	1227993.9	231555.6	2.4	-40.41
9	09-VP1	2014 Videoprobe Data	47.621905	-122.505909	1227972.2	231334.3	1.3	-44.65
11	11-VP1	2014 Videoprobe Data	47.621502	-122.505993	1227948.2	231187.5	1.1	-45.79
13	13-VP2	2014 Videoprobe Data	47.620987	-122.5061	1227917.8	231000.4	1.7	-43.12
14	14-VP1	2014 Videoprobe Data	47.621225	-122.505138	1228156.9	231082.1	2.8	-46.09
16	16-VP1	2014 Videoprobe Data	47.621586	-122.50518	1228149.2	231213.7	1.4	-49.01
17	17-VP1	2014 Videoprobe Data	47.622144	-122.505034	1228189.6	231416.5	1	-46.93
18	18-VP1	2014 Videoprobe Data	47.622524	-122.504937	1228216.6	231554.7	5.13	-44.31
19	19-VP1	2014 Videoprobe Data	47.622221	-122.504183	1228400.1	231440.3	2	-46.60
20	20-VP1	2014 Videoprobe Data	47.621977	-122.504265	1228378.0	231351.7	1.8	-48.13
22	22-VC1	2014 Core Data	47.621435	-122.504401	1228340.3	231154.7	1.3	-47.53
22	22-VP1	2014 Videoprobe Data	47.621447	-122.504366	1228348.9	231158.9	1.4	-47.84
23	23-VP1	2014 Videoprobe Data	47.621235	-122.50342	1228580.4	231076.5	1.8	-41.57
25	25-VP1	2014 Videoprobe Data	47.621708	-122.503458	1228574.8	231249.4	0.6	-47.38
26	26-VC1	2014 Core Data	47.621919	-122.503386	1228594.4	231325.6	3.1	-46.86
26	26-VP1	2014 Videoprobe Data	47.621908	-122.503386	1228594.2	231321.9	2.5	-46.96
27	27-VP1	2014 Videoprobe Data	47.622118	-122.503385	1228596.0	231398.3	3.7	-47.21
28	28-VP1	2014 Videoprobe Data	47.621725	-122.502713	1228758.8	231251.4	1.9	-46.48
29	29-VP1	2014 Videoprobe Data	47.621435	-122.502777	1228740.7	231145.9	1.2	-45.27
30	30-VP1	2014 Videoprobe Data	47.621489	-122.501944	1228946.3	231161.4	0.5	-48.41
31	31-VP1	2014 Videoprobe Data	47.621769	-122.501895	1228960.8	231263.2	1	-49.86
33	33-VP1	2014 Videoprobe Data	47.617559	-122.503388	1228559.4	229735.8	2.3	-22.69
34	34-VP1	2014 Videoprobe Data	47.617582	-122.503716	1228478.6	229745.8	5.5	-23.21
35	35-VP1	2014 Videoprobe Data	47.61764	-122.503989	1228411.7	229768.4	5.5	-24.04
36	36-VP1	2014 Videoprobe Data	47.617848	-122.503883	1228439.6	229843.8	4.6	-26.01
37	37-VC1	2014 Core Data	47.617822	-122.503775	1228465.9	229833.7	2.4	-26.23
37	37-VC2	2014 Core Data	47.617814	-122.503767	1228468.0	229830.9	2.85	-26.12
37	37-VP1	2014 Videoprobe Data	47.617827	-122.503749	1228472.4	229835.4	3.4	-26.06
38	38-VP1	2014 Videoprobe Data	47.617766	-122.503403	1228557.2	229811.4	1.9	-19.62
40	40-VP1	2014 Videoprobe Data	47.618297	-122.504043	1228403.7	230008.5	2.4	-32.02

Table 3-3. Current Station Elevations and Cap Thicknesses

Station Number	ID	Type	Latitude (degrees)	Longitude (degrees)	X[a] (ft)	Y[a] (ft)	Cap Thickness (ft)	Elevation (ft)[b]
41	41-VP1	2014 Videoprobe Data	47.618265	-122.503751	1228475.4	229995.3	0.8	-26.13
44	44-VP2	2014 Videoprobe Data	47.618576	-122.503676	1228496.4	230108.3	0	-26.43
45	45-VC1	2014 Core Data	47.618646	-122.504015	1228413.2	230135.6	1.2	-33.44
45	45-VC2	2014 Core Data	47.61864	-122.503977	1228422.7	230133.1	1.1	-33.28
45	45-VP1	2014 Videoprobe Data	47.61861	-122.503998	1228417.1	230122.2	2	-33.08
45	45-VP2	2014 Videoprobe Data	47.618636	-122.504016	1228413.0	230131.9	2	-33.36
50	50-VP1	2014 Videoprobe Data	47.620778	-122.50634	1227857.0	230925.3	2	-41.08
51	51-VP1	2014 Videoprobe Data	47.620706	-122.507522	1227565.0	230905.7	2	-39.29
52	52-VP1	2014 Videoprobe Data	47.622476	-122.504128	1228415.8	231532.8	3	-44.82
53	53-VC1	2014 Core Data	47.622059	-122.502718	1228760.0	231373.4	1.6	-47.94
53	53-VP1	2014 Videoprobe Data	47.622047	-122.502695	1228765.6	231368.6	2.2	-48.08
54	54-VP1	2014 Videoprobe Data	47.621102	-122.502875	1228713.8	231025.0	2.3	-42.17
55	55-VP1	2014 Videoprobe Data	47.619216	-122.504634	1228265.1	230346.6	2.1	-34.93
56	56-VP1	2014 Videoprobe Data	47.618984	-122.504241	1228360.3	230259.9	2.1	-34.86
57	57-VP1	2014 Videoprobe Data	47.61883	-122.504579	1228275.7	230205.7	2.5	-34.13
58	58-VP1	2014 Videoprobe Data	47.619227	-122.504253	1228359.3	230348.8	2.3	-32.44
F7	F-7	2011 Core Data	47.61953	-122.507262	1227619.8	230475.3	1.2	-36.00
F7	F7-VP1	2014 Videoprobe Data	47.619524	-122.507235	1227626.4	230472.9	1.6	-35.97
F9	F-9	2011 Core Data	47.618263	-122.50719	1227627.4	230013.0	1.5	-32.90
G4	G-4	2011 Core Data	47.621672	-122.506065	1227931.8	231249.9	0	-47.08
G8	G-8	2011 Core Data	47.618738	-122.50647	1227808.7	230182.4	1.8	-33.22
H10	H-10	2011 Core Data	47.617452	-122.505212	1228108.8	229706.4	5.8	-21.19
H2	H-2	2011 Core Data	47.622867	-122.505352	1228117.2	231681.9	4.7	-39.08
H9	H-9	2011 Core Data	47.61812	-122.505557	1228029.0	229952.0	4	-29.99
I10	I-10	2011 Core Data	47.617383	-122.504508	1228281.6	229677.7	5.1	-24.81
I3	I-3	2011 Core Data	47.622185	-122.504308	1228369.0	231427.7	2.4	-46.41
I5	I-5	2011 Core Data	47.620805	-122.504372	1228342.4	230924.8	1.5	-19.40
I5	I5-VP1	2014 Videoprobe Data	47.620792	-122.504393	1228337.1	230920.3	0.6	-20.09
I8	I-8	2011 Core Data	47.618922	-122.504437	1228311.5	230238.3	1.1	-34.69
I9	I-9	2011 Core Data	47.618075	-122.5045	1228289.2	229929.9	4.9	-27.38
J10a	J-10a	2011 Core Data	47.617578	-122.503537	1228522.8	229743.6	2.8	-24.15
J10b	J-10b	2011 Core Data	47.617628	-122.5033	1228581.5	229760.6	1.2	-20.89
J10c	J-10c	2011 Core Data	47.617422	-122.503485	1228534.3	229686.2	4.4	-22.64
J2	J-2	2011 Core Data	47.622923	-122.503702	1228524.4	231693.7	3	-42.43
J4	J-4	2011 Core Data	47.621765	-122.503593	1228542.0	231270.7	0.7	-48.00
J9a	J-9a	2011 Core Data	47.618167	-122.503252	1228597.7	229956.6	1.2	-7.96

Table 3-3. Current Station Elevations and Cap Thicknesses

Station Number	ID	Type	Latitude (degrees)	Longitude (degrees)	X[a] (ft)	Y[a] (ft)	Cap Thickness (ft)	Elevation (ft)[b]
J9b	J-9b	2011 Core Data	47.61825	-122.503563	1228521.5	229988.7	0	-20.31
J9c	J-9c	2011 Core Data	47.618035	-122.50354	1228525.6	229910.2	0	-21.73
J9d	J-9d	2011 Core Data	47.618215	-122.50307	1228642.9	229973.3	0	-4.8[c]

Notes:

[a] Washington State Plane North, NAD83 HARN, Feet.

[b] Elevation values are based on NOAA 2009 bathymetry data, converted from meters to feet.

[c] J-9d lies beyond the scope of the 2009 bathymetry data. The bathymetric value for this station was extrapolated from a nearby value.

Table 3-4. Target Cap Thickness Surface Elevations

									1.5 ft Cap		2 ft Cap		3 ft Cap		
Station Number	ID	Type	Latitude (degrees)	Longitude (degrees)	X[a] (ft)	Y[a] (ft)	Cap Thickness (ft)	Elevation (ft)[b]	Additional Cap Needed (ft)	Target Elevation (ft) MLLW	Additional Cap Needed (ft)	Target Elevation (ft) MLLW	Additional Cap Needed (ft)	Target Elevation (ft) MLLW	Area
1	01-VP2	2014 Videoprobe Data	47.62091	-122.507233	1227637.9	230978.5	1.29	-40.76	0.21	-40.55	0.71	-40.05	1.71	-39.05	3
2	02-VP1	2014 Videoprobe Data	47.621158	-122.507143	1227661.9	231068.2	0.9	-41.73	0.6	-41.13	1.1	-40.63	2.1	-39.63	3
3	03-VP1	2014 Videoprobe Data	47.62157	-122.507013	1227697.4	231217.9	0.5	-40.47	1	-39.47	1.5	-38.97	2.5	-37.97	3
4	04-VP1	2014 Videoprobe Data	47.621992	-122.506841	1227743.1	231371.1	0.5	-39.17	1	-38.17	1.5	-37.67	2.5	-36.67	3
6	06-VP1	2014 Videoprobe Data	47.622554	-122.506728	1227775.3	231575.1	0.5	-35.32	1	-34.32	1.5	-33.82	2.5	-32.82	NA
7	07-VC1	2014 Core Data	47.622507	-122.50577	1228011.1	231553.0	1.15	-41.89	0.35	-41.54	0.85	-41.04	1.85	-40.04	2
7	07-VP2	2014 Videoprobe Data	47.622513	-122.50584	1227993.9	231555.6	2.4	-40.41	0	-40.41	0	-40.41	0.6	-39.81	2
9	09-VP1	2014 Videoprobe Data	47.621905	-122.505909	1227972.2	231334.3	1.3	-44.65	0.2	-44.45	0.7	-43.95	1.7	-42.95	3
11	11-VP1	2014 Videoprobe Data	47.621502	-122.505993	1227948.2	231187.5	1.1	-45.79	0.4	-45.39	0.9	-44.89	1.9	-43.89	3
13	13-VP2	2014 Videoprobe Data	47.620987	-122.5061	1227917.8	231000.4	1.7	-43.12	0	-43.12	0.3	-42.82	1.3	-41.82	3
14	14-VP1	2014 Videoprobe Data	47.621225	-122.505138	1228156.9	231082.1	2.8	-46.09	0	-46.09	0	-46.09	0.2	-45.89	3
16	16-VP1	2014 Videoprobe Data	47.621586	-122.50518	1228149.2	231213.7	1.4	-49.01	0.1	-48.91	0.6	-48.41	1.6	-47.41	3
17	17-VP1	2014 Videoprobe Data	47.622144	-122.505034	1228189.6	231416.5	1	-46.93	0.5	-46.43	1	-45.93	2	-44.93	3
18	18-VP1	2014 Videoprobe Data	47.622524	-122.504937	1228216.6	231554.7	5.13	-44.31	0	-44.31	0	-44.31	0	-44.31	2
19	19-VP1	2014 Videoprobe Data	47.622221	-122.504183	1228400.1	231440.3	2	-46.60	0	-46.60	0	-46.60	1	-45.60	3
20	20-VP1	2014 Videoprobe Data	47.621977	-122.504265	1228378.0	231351.7	1.8	-48.13	0	-48.13	0.2	-47.93	1.2	-46.93	3
22	22-VC1	2014 Core Data	47.621435	-122.504401	1228340.3	231154.7	1.3	-47.53	0.2	-47.33	0.7	-46.83	1.7	-45.83	3
22	22-VP1	2014 Videoprobe Data	47.621447	-122.504366	1228348.9	231158.9	1.4	-47.84	0.1	-47.74	0.6	-47.24	1.6	-46.24	3
23	23-VP1	2014 Videoprobe Data	47.621235	-122.50342	1228580.4	231076.5	1.8	-41.57	0	-41.57	0.2	-41.37	1.2	-40.37	3
25	25-VP1	2014 Videoprobe Data	47.621708	-122.503458	1228574.8	231249.4	0.6	-47.38	0.9	-46.48	1.4	-45.98	2.4	-44.98	3
26	26-VC1	2014 Core Data	47.621919	-122.503386	1228594.4	231325.6	3.1	-46.86	0	-46.86	0	-46.86	0	-46.86	3
26	26-VP1	2014 Videoprobe Data	47.621908	-122.503386	1228594.2	231321.9	2.5	-46.96	0	-46.96	0	-46.96	0.5	-46.46	3
27	27-VP1	2014 Videoprobe Data	47.622118	-122.503385	1228596.0	231398.3	3.7	-47.21	0	-47.21	0	-47.21	0	-47.21	3
28	28-VP1	2014 Videoprobe Data	47.621725	-122.502713	1228758.8	231251.4	1.9	-46.48	0	-46.48	0.1	-46.38	1.1	-45.38	3
29	29-VP1	2014 Videoprobe Data	47.621435	-122.502777	1228740.7	231145.9	1.2	-45.27	0.3	-44.97	0.8	-44.47	1.8	-43.47	NA
30	30-VP1	2014 Videoprobe Data	47.621489	-122.501944	1228946.3	231161.4	0.5	-48.41	1	-47.41	1.5	-46.91	2.5	-45.91	NA
31	31-VP1	2014 Videoprobe Data	47.621769	-122.501895	1228960.8	231263.2	1	-49.86	0.5	-49.36	1	-48.86	2	-47.86	NA
33	33-VP1	2014 Videoprobe Data	47.617559	-122.503388	1228559.4	229735.8	2.3	-22.69	0	-22.69	0	-22.69	0.7	-21.99	NA
34	34-VP1	2014 Videoprobe Data	47.617582	-122.503716	1228478.6	229745.8	5.5	-23.21	0	-23.21	0	-23.21	0	-23.21	NA
35	35-VP1	2014 Videoprobe Data	47.61764	-122.503989	1228411.7	229768.4	5.5	-24.04	0	-24.04	0	-24.04	0	-24.04	NA
36	36-VP1	2014 Videoprobe Data	47.617848	-122.503883	1228439.6	229843.8	4.6	-26.01	0	-26.01	0	-26.01	0	-26.01	NA
37	37-VC1	2014 Core Data	47.617822	-122.503775	1228465.9	229833.7	2.4	-26.23	0	-26.23	0	-26.23	0.6	-25.63	NA
37	37-VC2	2014 Core Data	47.617814	-122.503767	1228468.0	229830.9	2.85	-26.12	0	-26.12	0	-26.12	0.15	-25.97	NA
37	37-VP1	2014 Videoprobe Data	47.617827	-122.503749	1228472.4	229835.4	3.4	-26.06	0	-26.06	0	-26.06	0	-26.06	NA
38	38-VP1	2014 Videoprobe Data	47.617766	-122.503403	1228557.2	229811.4	1.9	-19.62	0	-19.62	0.1	-19.52	1.1	-18.52	6
40	40-VP1	2014 Videoprobe Data	47.618297	-122.504043	1228403.7	230008.5	2.4	-32.02	0	-32.02	0	-32.02	0.6	-31.42	NA
41	41-VP1	2014 Videoprobe Data	47.618265	-122.503751	1228475.4	229995.3	0.8	-26.13	0.7	-25.43	1.2	-24.93	2.2	-23.93	6
44	44-VP2	2014 Videoprobe Data	47.618576	-122.503676	1228496.4	230108.3	0	-26.43	1.5	-24.93	2	-24.43	3	-23.43	6
45	45-VC1	2014 Core Data	47.618646	-122.504015	1228413.2	230135.6	1.2	-33.44	0.3	-33.14	0.8	-32.64	1.8	-31.64	NA
45	45-VC2	2014 Core Data	47.61864	-122.503977	1228422.7	230133.1	1.1	-33.28	0.4	-32.88	0.9	-32.38	1.9	-31.38	NA
45	45-VP1	2014 Videoprobe Data	47.61861	-122.503998	1228417.1	230122.2	2	-33.08	0	-33.08	0	-33.08	1	-32.08	NA
45	45-VP2	2014 Videoprobe Data	47.618636	-122.504016	1228413.0	230131.9	2	-33.36	0	-33.36	0	-33.36	1	-32.36	NA
50	50-VP1	2014 Videoprobe Data	47.620778	-122.50634	1227857.0	230925.3	2	-41.08	0	-41.08	0	-41.08	1	-40.08	3
51	51-VP1	2014 Videoprobe Data	47.620706	-122.507522	1227565.0	230905.7	2	-39.29	0	-39.29	0	-39.29	1	-38.29	3
52	52-VP1	2014 Videoprobe Data	47.622476	-122.504128	1228415.8	231532.8	3	-44.82	0	-44.82	0	-44.82	0	-44.82	2
53	53-VC1	2014 Core Data	47.622059	-122.502718	1228760.0	231373.4	1.6	-47.94	0	-47.94	0.4	-47.54	1.4	-46.54	3
53	53-VP1	2014 Videoprobe Data	47.622047	-122.502695	1228765.6	231368.6	2.2	-48.08	0	-48.08	0	-48.08	0.8	-47.28	3
54	54-VP1	2014 Videoprobe Data	47.621102	-122.502875	1228713.8	231025.0	2.3	-42.17	0	-42.17	0	-42.17	0.7	-41.47	NA
55	55-VP1	2014 Videoprobe Data	47.619216	-122.504634	1228265.1	230346.6	2.1	-34.93	0	-34.93	0	-34.93	0.9	-34.03	5
56	56-VP1	2014 Videoprobe Data	47.618984	-122.504241	1228360.3	230259.9	2.1	-34.86	0	-34.86	0	-34.86	0.9	-33.96	5
57	57-VP1	2014 Videoprobe Data	47.61883	-122.504579	1228275.7	230205.7	2.5	-34.13	0	-34.13	0	-34.13	0.5	-33.63	5
58	58-VP1	2014 Videoprobe Data	47.619227	-122.504253	1228359.3	230348.8	2.3	-32.44	0	-32.44	0	-32.44	0.7	-31.74	5
F7	F-7	2011 Core Data	47.61953	-122.507262	1227619.8	230475.3	1.2	-36.00	0.3	-35.70	0.8	-35.20	1.8	-34.20	4
F7	F7-VP1	2014 Videoprobe Data	47.619524	-122.507235	1227626.4	230472.9	1.6	-35.97	0	-35.97	0.4	-35.57	1.4	-34.57	4
F9	F-9	2011 Core Data	47.618263	-122.50719	1227627.4	230013.0	1.5	-32.90	0	-32.90	0.5	-32.40	1.5	-31.40	5
G4	G-4	2011 Core Data	47.621672	-122.506065	1227931.8	231249.9	0	-47.08	1.5	-45.58	2	-45.08	3	-44.08	3

Table 3-4. Target Cap Thickness Surface Elevations

									1.5 ft Cap		2 ft Cap		3 ft Cap		
Station Number	ID	Type	Latitude (degrees)	Longitude (degrees)	X[a] (ft)	Y[a] (ft)	Cap Thickness (ft)	Elevation (ft)[b]	Additional Cap Needed (ft)	Target Elevation (ft) MLLW	Additional Cap Needed (ft)	Target Elevation (ft) MLLW	Additional Cap Needed (ft)	Target Elevation (ft) MLLW	Area
G8	G-8	2011 Core Data	47.618738	-122.50647	1227808.7	230182.4	1.8	-33.22	0	-33.22	0.2	-33.02	1.2	-32.02	5
H10	H-10	2011 Core Data	47.617452	-122.505212	1228108.8	229706.4	5.8	-21.19	0	-21.19	0	-21.19	0	-21.19	NA
H2	H-2	2011 Core Data	47.622867	-122.505352	1228117.2	231681.9	4.7	-39.08	0	-39.08	0	-39.08	0	-39.08	2
H9	H-9	2011 Core Data	47.61812	-122.505557	1228029.0	229952.0	4	-29.99	0	-29.99	0	-29.99	0	-29.99	5
I10	I-10	2011 Core Data	47.617383	-122.504508	1228281.6	229677.7	5.1	-24.81	0	-24.81	0	-24.81	0	-24.81	NA
I3	I-3	2011 Core Data	47.622185	-122.504308	1228369.0	231427.7	2.4	-46.41	0	-46.41	0	-46.41	0.6	-45.81	3
I5	I-5	2011 Core Data	47.620805	-122.504372	1228342.4	230924.8	1.5	-19.40	0	-19.40	0.5	-18.90	1.5	-17.90	NA
I5	I5-VP1	2014 Videoprobe Data	47.620792	-122.504393	1228337.1	230920.3	0.6	-20.09	0.9	-19.19	1.4	-18.69	2.4	-17.69	NA
I8	I-8	2011 Core Data	47.618922	-122.504437	1228311.5	230238.3	1.1	-34.69	0.4	-34.29	0.9	-33.79	1.9	-32.79	5
I9	I-9	2011 Core Data	47.618075	-122.5045	1228289.2	229929.9	4.9	-27.38	0	-27.38	0	-27.38	0	-27.38	5
J10a	J-10a	2011 Core Data	47.617578	-122.503537	1228522.8	229743.6	2.8	-24.15	0	-24.15	0	-24.15	0.2	-23.95	NA
J10b	J-10b	2011 Core Data	47.617628	-122.5033	1228581.5	229760.6	1.2	-20.89	0.3	-20.59	0.8	-20.09	1.8	-19.09	6
J10c	J-10c	2011 Core Data	47.617422	-122.503485	1228534.3	229686.2	4.4	-22.64	0	-22.64	0	-22.64	0	-22.64	NA
J2	J-2	2011 Core Data	47.622923	-122.503702	1228524.4	231693.7	3	-42.43	0	-42.43	0	-42.43	0	-42.43	1
J4	J-4	2011 Core Data	47.621765	-122.503593	1228542.0	231270.7	0.7	-48.00	0.8	-47.20	1.3	-46.70	2.3	-45.70	3
J9a	J-9a	2011 Core Data	47.618167	-122.503252	1228597.7	229956.6	1.2	-7.96	0.3	-7.66	0.8	-7.16	1.8	-6.16	6
J9b	J-9b	2011 Core Data	47.61825	-122.503563	1228521.5	229988.7	0	-20.31	1.5	-18.81	2	-18.31	3	-17.31	6
J9c	J-9c	2011 Core Data	47.618035	-122.50354	1228525.6	229910.2	0	-21.73	1.5	-20.23	2	-19.73	3	-18.73	6
J9d	J-9d	2011 Core Data	47.618215	-122.50307	1228642.9	229973.3	0	-4.8[c]	1.5	-3.30	2	-2.80	3	-1.80	6

Notes:
MLLW = mean lower low water
NA = not applicable.

[a] Washington State Plane North, NAD83 HARN, Feet.
[b] Elevation values are based on NOAA 2009 bathymetry data, converted from meters to feet.
[c] J-9d lies beyond the extent of the 2009 bathymetry data. The elevation value for this station was extrapolated from a nearby value.

Table 3-5. Estimated Volumes of Additional Cap Material Needed per Area and Target Thickness

Target Cap Thickness	Additional Material Needed (Cubic Yards)
1.5 ft	
Area 1	1,200
Area 2	410
Area 3	8,400
Area 4	3,300
Area 5	1,600
Area 6	2,500
2 ft	
Area 1	3,100
Area 2	800
Area 3	17,000
Area 4	6,600
Area 5	6,200
Area 6	3,700
3 ft	
Area 1	8,400
Area 2	2,100
Area 3	39,000
Area 4	23,000
Area 5	20,000
Area 6	6,500

Table 3-6. Tally of Data Points and Average Spacing per Subarea

Area #	# Data Points	Area (ft^2)	Average Spacing Between Data Points (ft)
Area 1	1	367,261	NA
Area 2	5	128,735	72
Area 3	27	656,789	30
Area 4	2	493,971	351
Area 5	9	637,432	89
Area 6	8	76,453	35
# Data Points Not Included in Volumetric Subareas	23		
Total Count	75		

Note:

Average spacing was calculated by dividing the square root of the area by the number of samples.

NA = not applicable.

APPENDIX A

FINAL WORK PLAN

WORK PLAN

Wyckoff/Eagle Harbor
Evaluation of Sediment Cap Condition at
East Harbor Operable Unit

Prepared for
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February 24, 2014

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ACRONYMS AND ABBREVIATIONS

DNR	Washington State Department of Natural Resources
EPA	U.S. Environmental Protection Agency
GIS	geographic information system
GPS	global positioning system
MLLW	mean lower low water
NAD	North American Datum
PAH	polycyclic aromatic hydrocarbon
QA	quality assurance
ROV	remotely operated vehicle
SBP	subbottom profiler
USACE	U.S. Army Corps of Engineers

1 INTRODUCTION

The Wyckoff / Eagle Harbor Superfund site is located on Bainbridge Island, Washington (Figure 1-1). The East Harbor Operable Unit includes more than 70 acres of intertidal and subtidal habitats that were contaminated by releases of creosote and other wood-treating chemicals from a previous wood-treating plant (DNR 2013). The primary sediment contaminants are polycyclic aromatic hydrocarbons (PAHs). In 1994–95, the U.S. Environmental Protection Agency (EPA) placed a cap consisting of a 3-ft thick layer of clean dredged sand over more than 50 acres of contaminated sediment in the harbor (Phase 1). Additional subtidal capping took place in 2000 (Phase 2) and 2001 (Phase 3) (Figure 1-1; DNR 2013).

The cap has been monitored regularly since its construction (DNR 2013). The most recent monitoring, performed in 2011 (HDR et al. 2012), showed that most of the cap is physically stable and continues to protect benthic organisms and fish from exposure to PAHs in the buried sediment. However, there were several areas noted where the Phase 1 cap material has eroded to the extent that it is no longer present, or is too thin to provide adequate chemical isolation. One area is within the Washington State ferry lane, where sediment monitoring, erosion modeling, and measured bottom current velocities suggest that the currents generated by the ferry prop wash have eroded sections of the cap (DNR 2013). Another area is offshore of the former facility's West Dock, in an area of the site referred to as J9/J10, where the 2011 monitoring found contaminant concentrations just below the sediment surface exceeding the Washington State sediment quality standards (HDR et al. 2012). In the case of 19/110, the area is on the margins of sequential past capping efforts, so there is some uncertainty as to whether this area initially received 3 feet of material during construction, or if some post-project redistribution and/or slumping may have occurred.

EPA plans to patch the cap to isolate contaminated sediment and armor the newly capped areas as needed to prevent future erosion (DNR 2013). As manager of state-owned aquatic lands, the Washington State Department of Natural Resources (DNR) is coordinating with EPA and the U.S. Army Corps of Engineers (USACE), Seattle District, to conduct this investigation to map where and how much additional cap material is needed to be protective of state-owned lands.

The sand used to construct most of the original 50+ acre Phase I cap was dredged from state-owned aquatic lands in the Snohomish River as part of a Federal navigation maintenance project. DNR is a participating agency in the regional dredged material management program and coordinates regularly with the other DMMP agencies, EPA, the Corps of Engineers, and Ecology on dredging and beneficial re-use projects.

In support of the investigation objective stated above, goals for the field effort are:

1. To collect measurements of cap thickness in the investigation areas so that the volume of material needed may be calculated

2. To refine the boundaries of where additional material is needed
3. To identify in the J9/J10 area where the cap material is not present.

2 SAMPLING PLAN APPROACH AND METHODS

The approach for this investigation is to employ a variety of technologies in a phased sequence, and to adapt the approach of each subsequent phase based on the findings of the preceding technology. The four phases proposed involve the following:

1. Remotely operated vehicle (ROV) video survey
2. Down-hole video-coring
3. Sediment vibracoring
4. Subbottom profiling (this phase is contingent upon evaluation of the results from Phases 2 and 3).

Field staff will coordinate closely with EPA regarding the findings of each phase of the field investigation and any modification of this plan based on field results. The designated EPA contact is Helen Bottcher. The details of each phase of this field investigation approach are discussed below.

2.1 PHASE 1—ROV VIDEO SURVEY

The first phase of this investigation involved the use of EPA's ROV to conduct a video survey of the bottom conditions in the area off the ferry dock and in area J9/J10. The ROV survey was conducted on October 30 and 31, 2013, along 19 transects—14 in the Phase 1 cap area along the ferry path and 5 in the J9/J10 area. Observations and interpretations of surface sediment characteristics and features made by Mr. Dave Browning, the lead project geologist, during the survey are summarized in Table 2-1 and mapped in Figure 2-1. Note that due to the inability to record precise locations of the ROV as it ran the transects, the distances along transects for observations noted in the table, and the locations of features shown on the map, are approximate, and observations along the transect J9E, which followed a variable course, are not shown on Figure 2-1. In spite of the location tracking limitations, the ROV survey provided useful information on bottom surface sediment conditions, including sediment texture, bed hardness, and indicators of hydraulic reworking such as bedforms and winnowed lag deposits, that allowed an approximate location of the transition between cap/no cap conditions to be identified on most transects (Figure 2-1). These data were used in the planning of the proposed sediment coring phase of the investigation.

2.2 PHASE 2—VIDEOCORING AND VIBRACORING

A sediment coring investigation utilizing both down-hole video (videocoring) and the collection of sediment cores via vibracoring is proposed to map the vertical extent of the existing sediment cap and identify areas where augmentation is needed. Coring data will also be used to fill in data gaps regarding the areal extent of cap erosion. Videocoring and vibracoring will be conducted from the sampling vessel R/V *Nancy Anne* operated by Marine Sampling Systems, Burley, Washington. All coring and core processing work will be conducted in accordance with Integral's site health and safety plan (Appendix A).

2.2.1 Navigation

Prior to the survey, target station coordinates will be entered into the sampling vessel's navigation system. The *Nancy Anne* is equipped with a Trimble AG132 differential global position system (DGPS) receiver and computer navigation software. The DGPS receiver will be situated over the sampling gear to acquire the most accurate position for each core. The positional accuracy will be ± 2 m. Accuracy of the GPS will be verified at a horizontal control or navigation check point daily before beginning sampling activities. The vessel will maneuver to the target coordinate location (± 6 m) for sampling. A positional fix will be recorded when the corer impacts the seafloor. Horizontal coordinates will be recorded as latitude and longitude (North American Datum [NAD] 83) to the nearest 0.1 second (i.e., 10^{-5} degree).

Vertical control will be established from an existing National Oceanic and Atmospheric Administration tide station (ID # 9447130) located on the downtown Seattle waterfront, or another appropriate nearby station. Water depths at coring stations will be measured by lead-line and the vessel's fathometer. All depth measurements will be corrected to mean lower low water (MLLW).

2.2.2 Videocoring

The videocore probe consists of a sapphire-surfaced oval lens fitted at a 45-degree angle to a 6-ft length of thin (1.9 inches diameter) stainless steel pipe. The lens allows a 1-inch^2 window for visual observation of sediment conditions. The probe is advanced through the sediment by gravity, or by briefly vibrating the core using a pneumatic vibrating system. Observations during videocoring will be recorded at depths of key stratigraphic changes, at a minimum, along with the occurences of other notable features such as debris, NAPL, etc. The presence/absence of cap material, which differs in both color and grain size from the underlying native sediment, will be noted at each station. All observations will be made by or under the supervision of Mr. Browning, the lead project geologist. The Marine Sampling Systems' videocore system uses a 200 khtz depth sounder for depth control and/or a magnetically tripped counter (17 counts/foot) with a digital read out. Estimated accuracy of the depth measurements is 3 inches or better. The depths of observations will be related to mean lower low water (MLLW) based on tide level and the location's water depth at the time observations are made.

The videocoring system has a feed to a VCR/videotape. The videotape system has a microphone to allow for voiceover dubbing to provide time and depth information as well as

Dave Browning's realtime comments/notes. The videotape and transcription of the audio notes will be part of the data deliverables package.

The proposed locations for videocore observations are shown in Figure 2-2 and listed in Table 2–2. Because the purpose of the videocoring is to determine the presence/absence boundary of the cap material, stations on the outer edges of the transect will be prioritized over stations farther in from the edges. The preliminary results from the outer stations will inform the need to conduct videocoring at the inner stations. Note that all but one of the "secondary" videocore locations close to the ferry terminal dock in Figure 2-2 are outside the boundary of the Phase I cap, and are lower priority than the "primary" locations. Timing the access to these secondary locations will be challenging due to proximity to the ferry. These locations may only be surveyed if field observations indicate that data at these locations are needed and if conditions allow.

The video coring data collection effort is expected to take place over 2 days, followed by 1 day of data evaluation and interpretation. The interpretation of cap conditions based on data from the videocoring effort will be ground-truthed in select locations by direct observations of cap thickness in sediment vibracores.

2.2.3 Vibracoring

Six locations are proposed for vibracoring (Figure 2-2, Table 2-3). The primary purpose of the vibracoring phase is to fill data gaps remaining after videocoring survey (e.g., to confirm observations made during videocoring, provide data where videocoring was unsuccessful or unclear, etc.). The locations of the vibracores shown in Figure 2-2 (and listed in Table 2-3) are for illustrative purposes only. The actual target locations of the vibracores will be determined during consultation with the Agency Team during review of the videocoring survey results after the video survey is completed. At least one vibracore will be co-located with a videocore station in both the ferry zone and J9/J10 area to verify observations made with the videocore. The number and locations of vibracores may be altered based on results obtained during the videocoring or other conditions observed in the field.

The vibracorer uses a pneumatic system that vibrates and drives a length of 4-in. outer diameter aluminum tubing into the sediment. Marine Sampling System's vibracorer does not require a core liner. A continuous sediment sample is retained within the tubing with the aid of a stainless-steel core catcher.

At each vibracore station, the cores will be driven to a depth of at least 6 ft below the sediment surface, if possible given the sediment texture. The sediment recovery objective is 80 percent of the driven core length, or 4.8 ft of a 6 ft core. If the initial attempt at a given location fails to achieve a sediment recovery of 80 percent, up to two additional attempts will be made to achieve the recovery objective at that location. If not achieved, then the highest percent recovery core will selected for processing and detailed description. All rejected sediment cores will be retained for disposal at the Wyckoff facility.

Once the core is onboard the sampling vessel, the overlying water will be siphoned from the top of the core. Empty tubing will be removed to ensure that each section is full of sediment, which will limit disturbance during storage and transport. The core tube containing sediment may be cut into smaller sections if necessary for ease of transport. A label identifying the station and core section will be securely attached to the outside of the casing at the *top* of each section. Core sections will be labeled A, B, etc. as appropriate, according to their depth sequence. For example, the uppermost section of a core will be labeled "A" preceded by the boring number, and the section below it will be labeled "B", etc. Sediment at the end of each tube section cut will be visually classified for qualitative characteristics in the field. Changes from the top to the bottom of each section of the tube will be noted and recorded in the field log or sampling form. The core ends will then be covered with aluminum foil and a protective cap, which will be sealed with duct tape to minimize leakage.

After all cores are collected they will be transported to an onshore facility that will be set up on the Wyckoff property for processing and description. The cores will remain in the custody of field sampling personnel during transit between the vessel and processing laboratory and will be transported and stored upright to the extent practical. Because no samples will be collected, refrigerating the cores will not be necessary.

The core tubes will be opened by placing each core on a core-cutting table and cutting along the long axis using a circular saw. The tube will then be rotated 180° and cut again. After each core is cut, the entire core tube will be moved to a table and opened. Each sediment core will then be photographed, and a description of the core will be recorded on a core log form (Appendix B). The description will include the following information:

- Core penetration depth and recovery
- Physical soil description (i.e., soil classification, density/consistency, color)
- Odor (e.g., hydrogen sulfide, petroleum)
- Visual stratification
- Debris
- Evidence of biological activity (e.g., detritus, shells, tubes, bioturbation, live or dead organisms)
- Presence of oil sheen
- Identification of the presence or absence of a cap layer, and its vertical extent if present.

The thickness of the sediment cap layer will be measured in each core, if present, and recorded. Identification of the cap material layer will be made under the supervision of the lead project geologist. Because the purpose of the vibracores is to document the thickness of the sediment cap, no sediment sampling for laboratory analysis is anticipated.

2.3 PHASE 3—SUBBOTTOM PROFILING

The video and vibracoring effort will provide information on cap conditions at specific points in Eagle Harbor. Following evaluation of the investigation results through Phase 2, information from the 2011 cap monitoring results, and consultation with the Agency Team, a third investigation phase involving subbottom profiling conducted by Sea Engineering, may be implemented. Subbottom profile data, when coupled with ground-truth results from the vibracoring effort, may be able to further delineate cap thickness across the East Harbor Operable Unit.

Subbottom profilers (SBPs) emit an acoustic pulse that travels down through the water column and into the sediment/substrate. Sound intensity is reflected back when different impedances are encountered (e.g., water–sediment interface, density changes beneath the sediment surface). Sensing interfaces such as this one is one primary capability of subbottom profilers. Two Edgetech CHIRP type SBPs are proposed for use at the site due to the uncertainty in the substrate layers, and whether a density change, or impedance difference will be sensed: Edgetech SB216 and Edgetech SB424. CHIRP systems emit several different frequencies within the pulse because different frequencies may penetrate the subsurface differently. The Edgetech SB216 has several frequency ranges between 2 and 16 kHz. The Edgetech SB424 has several frequency ranges between 4 and 24 kHz. The decibel (dB) level generated by the subbottom profiling system is estimated at 212 dB (Magalen 2014, pers. comm.). The SB216, because of its lower frequency range, will be able to penetrate deeper into the substrate, but will have a slightly coarser resolution. The depth penetration capability of the SB424 may be less than the SB216, but it is able to sense subsurface horizons to a finer resolution.
There is a degree of uncertainty as to whether subbottom profiling will be able to sense the interface between the cap and the native material beneath. However, this uncertainty is reduced by using both proposed systems.

The SBPs will be deployed along transects spaced approximately 50 ft apart within the target survey area shown in Figure 2-3.

2.4 DECONTAMINATION

The videocoring, vibracoring, and SBP survey subcontractors are responsible for determining the proper decontamination procedures for their nondisposable survey equipment. The SBP survey equipment will be towed behind the survey vessel and is not expected to contact contaminated sediment.

All nondisposable components of the core processing equipment that contact the sediment will be decontaminated using the following steps:

1. Rinse with site water or tap water
2. Wash or wipe with Alconox or Liquinox detergent solution
3. Rinse with site water or tap water
4. If visible sheen/residue remains on nondisposable sampling equipment, wipe with solvent (hexane) on a paper towel and repeat Alconox/Liquinox wash (if appropriate)
5. Rinse with site water or tap water
6. Allow to air dry.

If used per step 4 above, decontamination solvent on paper towels evaporates quickly. After the solvent is evaporated the paper towels will be disposed of as nonhazardous solid waste.

Reusable personal protective equipment (e.g., boots, raingear) will be washed, as needed, with a detergent solution and rinsed with potable or site water. Water or incidental sediment spilled on the deck of the coring vessel will be rinsed into the surface waters at the collection site. If sediment contamination is obvious (e.g., a petroleum sheen is present), the sediment will be containerized to be disposed of with the waste sediment from the vibracore processing.

2.5 INVESTIGATION-DERIVED WASTE DISPOSAL

Investigation-derived waste materials will include disposable field supplies (such as nitrile gloves, used aluminum foil, paper towels, etc.), excess sediment, and waste decontamination fluids. Disposable field supplies and personal protective equipment, washed or brushed free of excess sediment, will be contained in plastic trash bags and disposed of through the Wyckoff facility. Decontaminated waste aluminum core tubing will be submitted for recycling or if decontamination is not practicable, disposed of through the Wyckoff facility. Excess sediment from vibracore processing will be placed on the waste soil stockpile at the Wyckoff facility. Coring waste decontamination fluids (detergent solution and rinse waters) will be disposed through the Wyckoff facility wastewater treatment plant.

3 QUALITY ASSURANCE REVIEW AND DATA COMPILATION

This section describes quality assurance (QA) reviews and data compilation for data collected in the field.

3.1 NAVIGATION DATA

The ± 2 m accuracy of the sampling vessel navigation system will be verified by the daily checks at the horizontal control or navigation check point conducted prior to beginning coring activities. All location data including navigation checks will be tabulated and provided in the investigation data report (see Section 4).

3.2 VIDEOCORE DATA

Observations of apparent sediment texture will be tabulated based on observations made during videocoring, and referenced to station locations. Tabulated observations from the videocores will include determination of the presence or absence of cap material at each location and identification of the depth of the cap/native sediment interface if present and discernible. Recorded observations will be checked to the survey videotape.

3.3 VIBRACORE DATA

Data collected from the vibracores will include stratigraphic descriptions of sediment deposits in the vibracores and the identification of the cap/native sediment interface depth, if present.

3.4 SUBBOTTOM PROFILE DATA

Sea Engineering will conduct a QA review of the subbottom profile data and will provide a copy of the subbottom profile transect imagery and map of interpreted cap/sediment bed thickness.

4 DATA INTERPRETATION, REPORTING, AND SCHEDULING

The goals for investigation data interpretation, reporting, and schedule are discussed in this section.

4.1 DATA INTERPRETATION

The results of the ROV video, videocoring, vibracoring, and SBP investigations will be compiled and mapped to show the thickness of existing cap material based on interpretation of the field data. From this information, the area and volume of additional cap material needed to obtain a target minimum cap thickness of 3 ft will be calculated and mapped.

4.2 REPORTING

The results of this investigation will be presented in a brief data summary report that will include a description of the work performed, the methods used, and the results including maps that delineate the location and size of the area(s) where cap material is missing and a calculation of the approximate volume of cap material that will be needed to restore the impacted areas to the original cap design depth of 3 ft. The report will also include the sampling plan, cruise safety plan, and field logs as appendices. Investigation data will be provided in electronic format, including geographic information system (GIS) files showing the location of areas needing additional cap material.

Following review and approval of the draft report by the DNR, EPA, and USACE, the final report will be provided in electronic formats (Microsoft® Word and PDF) on compact disc. All electronic formats will be stand-alone products requiring no additional fonts or software other than those provided in the off-the-shelf versions of Word, Acrobat Reader, and ARC GIS. All figures included in the report will also be provided in a separate folder as stand-alone PDFs.

4.3 SCHEDULE

The initiation of the coring fieldwork, following approval of this work plan, is anticipated to begin on or near March 5, 2014.

Video- and vibracoring is expected to be completed within 5 field days: 2 days of videocoring at the proposed locations, followed by 1 day of reviewing the videocore data with the Agency Team and reevaluating the proposed vibracore locations based on the data, and then 1 day of vibracore collection followed by 1 day of vibracore processing. The subbottom profile survey, if conducted based on Agency Team consultation, is expected to be initiated after the completion of the coring effort and be completed within 1 day, with 1 subsequent day for data processing.

The draft data report will be submitted for agency review 4 weeks after the completion of fieldwork, likely mid- to late April, 2014.

5 REFERENCES

DNR. 2013. PSC 11-107, Modified Task Order #5, September 26, 2013, Eagle Harbor Sediment Cap Condition/Erosion. Submitted to Integral Consulting Inc., Olympia, WA. Washington State Department of Natural Resources, Olympia, WA.

HDR, SEE, and KTA. 2012. 2011 Year 17 Monitoring Report, East Harbor Operable Unit, Wyckoff/Eagle Harbor Superfund Site. Prepared for US Environmental Protection Agency Region 10, and U.S. Army Corps of Engineers Seattle District. Prepared by HDR Engineering, Inc., Olympia, WA, Science and Engineering for the Environment, LLC, Seattle, WA, and Ken Taylor Associates, Inc., Seattle, WA. September 7, 2012.

Magalen, J. 2014. Personal communication (email to S.FitzGerald, Integral Consulting Inc., Seattle, WA, dated February 2, 2014, regarding the decibel level associated with the proposed subbottom profiling system). Sea Engineering, Santa Cruz, CA.

FIGURES

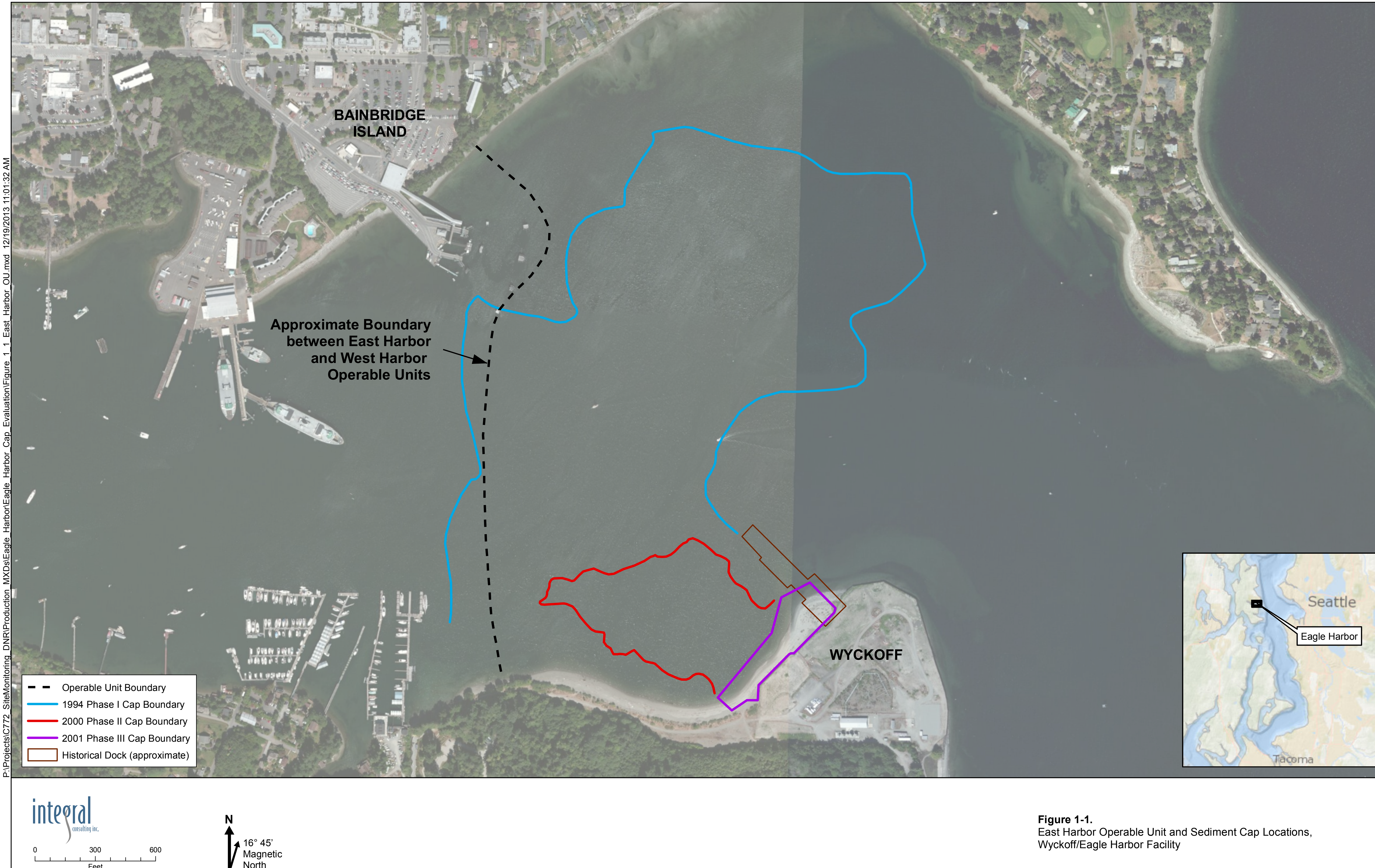

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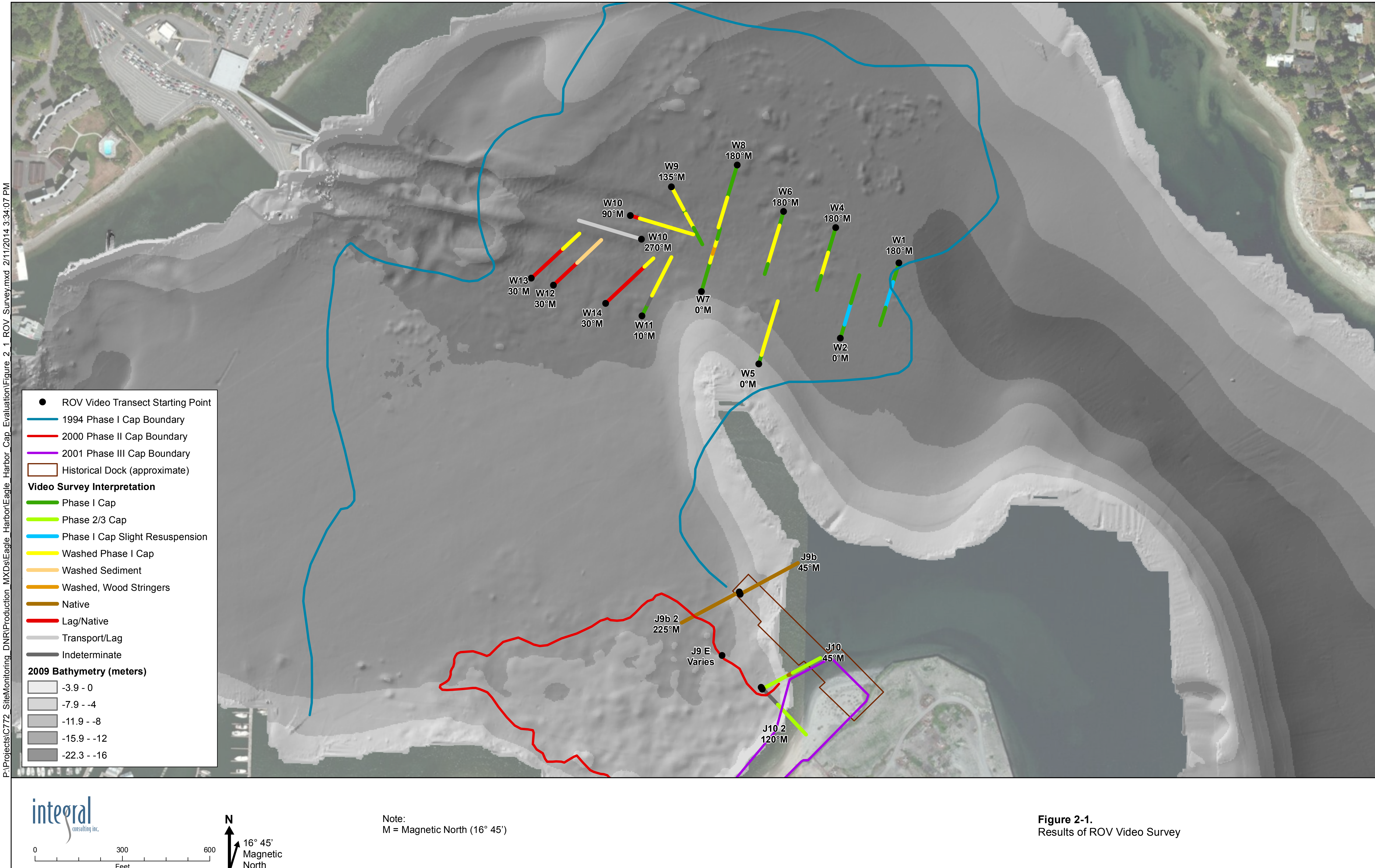
Figure 1-1.
East Harbor Operable Unit and Sediment Cap Locations, Wyckoff/Eagle Harbor Facility



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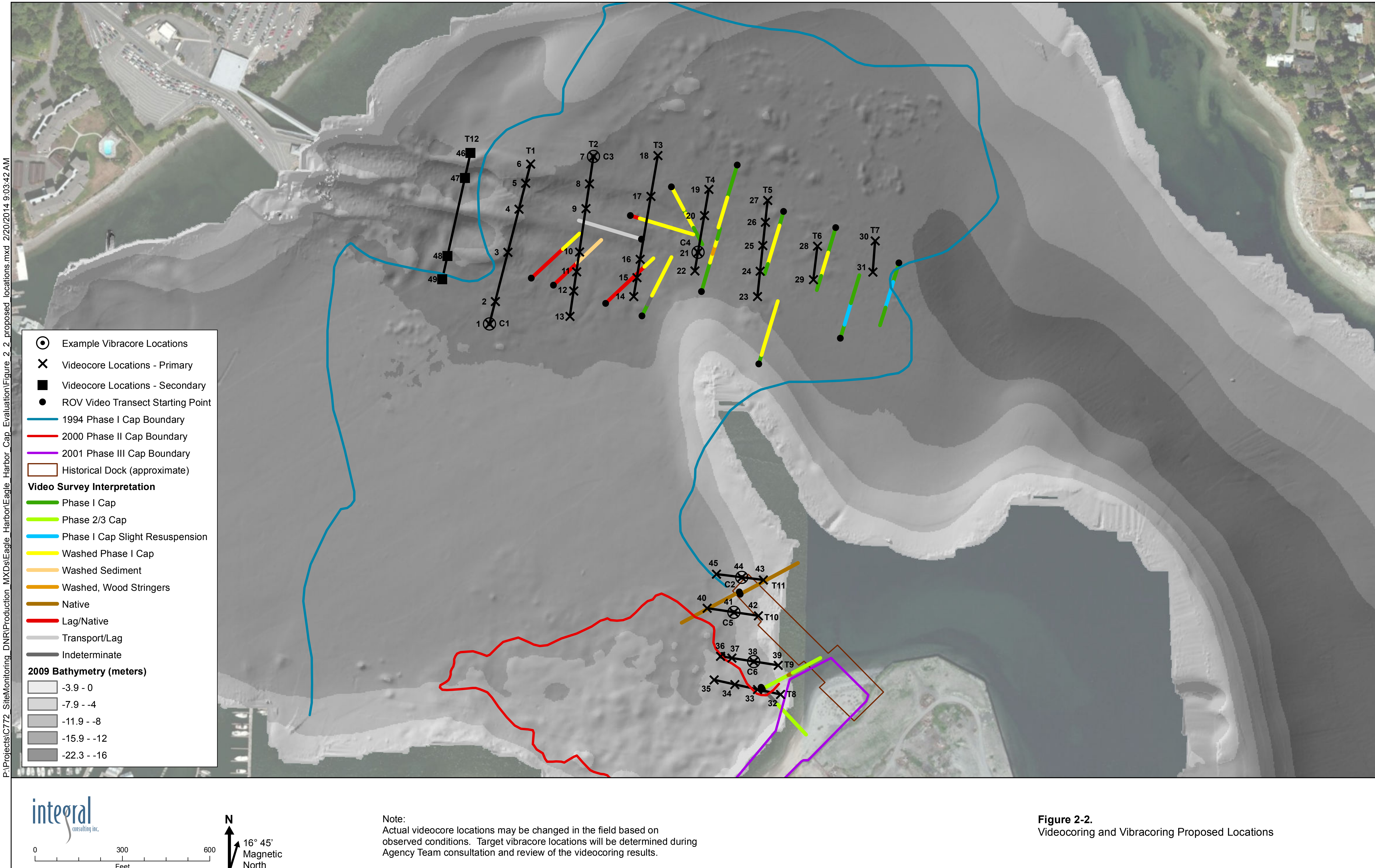
integral consulting inc.

Note:
M = Magnetic North (16° 45')

Figure 2-1.
Results of ROV Video Survey



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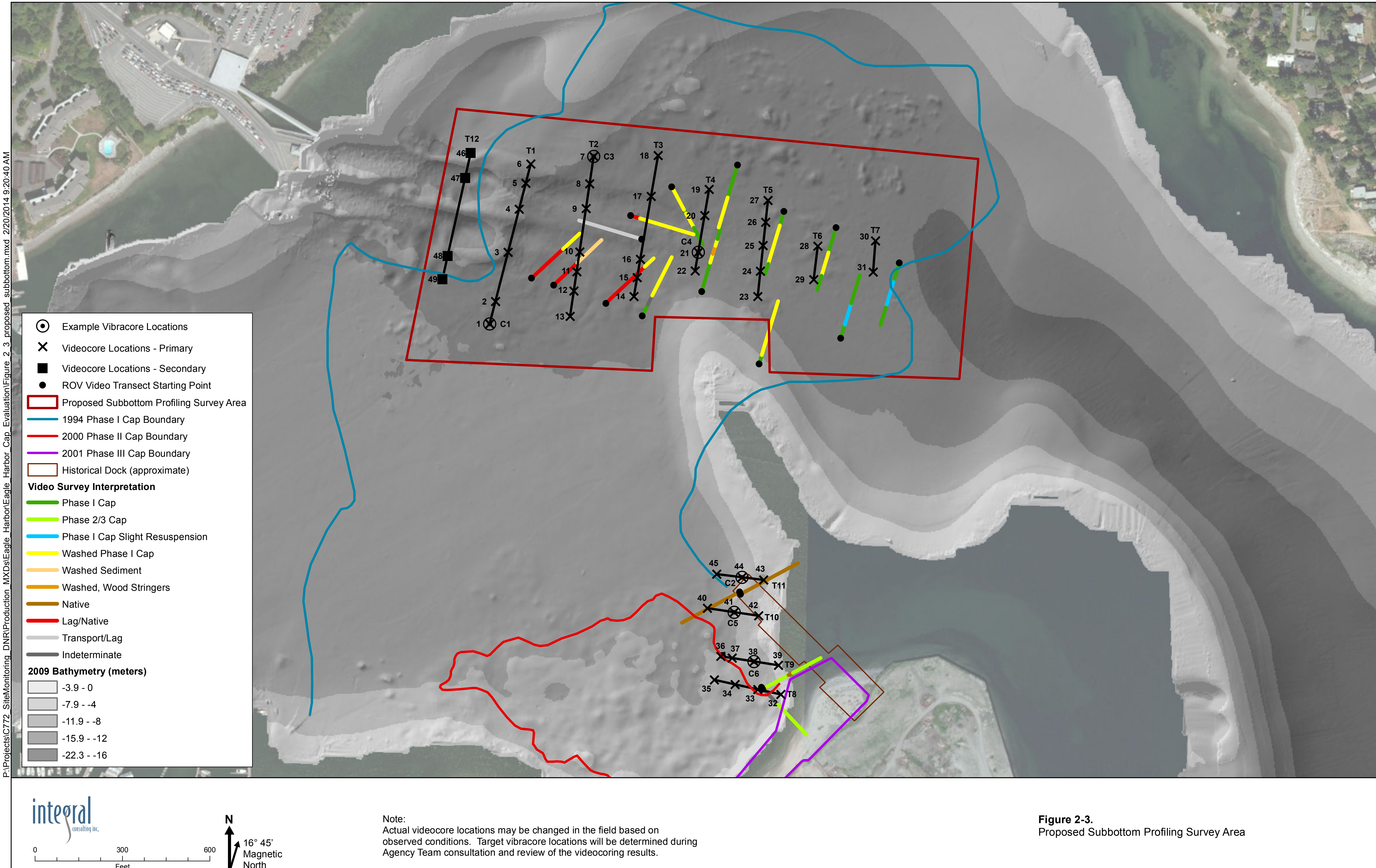
Note:
Actual videocore locations may be changed in the field based on observed conditions. Target vibracore locations will be determined during Agency Team consultation and review of the videocoring results.

Figure 2-2.
Videocoring and Vibracoring Proposed Locations



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Note:
Actual videocore locations may be changed in the field based on observed conditions. Target vibracore locations will be determined during Agency Team consultation and review of the videocoring results.

Figure 2-3.
Proposed Subbottom Profiling Survey Area

TABLES

Table 2-1. Observations from ROV Video Survey, October 30-31, 2013

Transect	Heading (Degrees Magnetic)	Start Date and Time	Video Duration	Latitude	Longitude	Travel time	Distance along transect (feet)	Elapsed Time	Feature Observation Notes	Interpretation
W1	180	10/30/2013 11:05	10:52	47.62387	122.44256	0	0	2:01	Reaching seafloor	Phase 1 Cap
						0	0	3:03	Starting to move	Phase 1 Cap
						64	42	4:07	Kelp?/*Laminaria* ? Slightly rippled seafloor with fines over sand.	Phase 1 Cap
						105	69	4:48	Attempt to push into sediment and sediment hard. Becoming increasingly sandy. Cluster of barnacle encrusted debris and metridium. Surface washed. Clearly sand based on sediment repose of large burrow walls.	Phase 1 Cap
						114	75	4:57	Increasing amount of debris without detrital coating/washing.	Phase 1 Cap slight resuspension
						128	84	5:11	External lighting sediment-water interface on.	Phase 1 Cap slight resuspension
						137	90	5:20	ROV impacted/brushed sediment and cloud of detrital fines stirred up, otherwise features of sediment surface seemingly indicate a sandy substrate.	Phase 1 Cap slight resuspension
						165	108	5:48	Contact sediment surface and fines release. Burrowed sediment with small patches of wood fragments and adhering algae.	Phase 1 Cap slight resuspension
						184	120	6:07	Contact sediment and small amount of fines released but otherwise a stiff and sandy substrate.	Phase 1 Cap slight resuspension
						203	133	6:26	Freshly excavated epifaunal depression with ring of newly exhumed sediment surrounding depression.	Phase 1 Cap slight resuspension
						226	148	6:49	Log with metridium.	Phase 1 Cap slight resuspension
						246	161	7:09	Transitioning from washed sediment surface to a slightly rippled surface with sequestration of some surficial fines.	Phase 1 Cap slight resuspension
						282	184	7:45	Poking sediment and a small clouds of fines. Near end of tether. Some sand and shell visible.	Phase 1 Cap
						307	201	8:10	Intensively burrowed likely slightly silty sand.	Phase 1 Cap
						344	225	8:47	End of transect.	Phase 1 Cap
W2	0	10/30/2013 11:29	12:05	47.62085	122.50233	0	0	1:58	At sediment surface.	Phase 1 Cap
						0	0	2:04	Silty sand with abundant burrows and epifaunal tracks. Algae. Some detrital mantling.	Phase 1 Cap
						17	8	2:21	Push into sediment. Firm, appears to be slightly silty sandy and holds together.	Phase 1 Cap
						97	48	3:41	Push into sediment. Appears to be silty sand that holds shape when plowed. Seafloor in relatively uniform from 02:04 until now.	Phase 1 Cap
						146	72	4:30	Gradually transitioning into area where sediment surface is better washed, fewer burrows and exposed disarticulated shells.	Phase 1 Cap slight resuspension
						176	87	5:00	Push into sediment, silty sandy with minor cloud of fines upon impact.	Phase 1 Cap slight resuspension
						214	106	6:08	Push into sediments. Very silty sand with cloud readily released upon impact.	Phase 1 Cap slight resuspension
						254	125	6:48	Scattered wood fragments and debris with fluting around them. Slight transport/resuspension. Fewer burrows.	Phase 1 Cap slight resuspension
						273	135	7:07	Transitioning back into detrital mantle, very silty sand with abundant infaunal burrows.	Phase 1 Cap

Table 2-1. Observations from ROV Video Survey, October 30-31, 2013

Transect	Heading (Degrees Magnetic)	Start Date and Time	Video Duration	Latitude	Longitude	Travel time	Distance along transect (feet)	Elapsed Time	Feature Observation Notes	Interpretation
						378	187	8:52	Nice epifaunal burrow/pit with some minor scattered, partially detritally mantled wood fragments. Barnacle encrusted bottle.	Phase 1 Cap
						451	223	10:05	Attempting to push into sediment. Appears to be firm slightly silty sand. End of tether.	Phase 1 Cap
						456	225	10:10	End of transect, start hand retrieval.	Phase 1 Cap
W12	30	10/30/2013 11:51	13:03	47.62129	122.50634	0	0	1:23	Bottom, field of cobble and shell fragments over sand/silt that appears not to be cap material.	Lag/Native
						0	0	2:24	Attempt to push into sediment. Hard. Cobbles/gravels and shell. Scour residue.	Lag/Native
						11	5	2:35	Gray granular sand (likely coarse and angular) appears different from cap material.	Lag/Native
						48	23	3:12	Gravels and shell, no cap material.	Lag/Native
						63	30	3:27	Gravels and shell, no cap material.	Lag/Native
						76	36	3:40	Transitioning from armored sand to sand.	Lag/Native
						94	44	3:58	Attempt to push into sediment, hard granular sand with some shell fragments. Appears different from cap sands.	Lag/Native
						172	81	5:06	Armored sand/lag.	Lag/Native
						176	83	5:10	Bivalve siphon.	Lag/Native
						234	111	6:08	Continued sand with shell/gravel surficial lag. Attempt to push into sediment, sediment is hard/firm.	Lag/Native
						298	141	7:12	Starting to transition into sand with some surficial or trapped detritus/fines in upper sediment column. Possibly getting into cap sediment.	Washed Sediment
						316	149	7:30	Attempt to push into sediment. Still dominantly sand but minor amount of fines released.	Washed Sediment
						331	156	7:45	Some leaf debris at sediment-water interface.	Washed Sediment
						349	165	8:03	Small woody debris that has thin detrital coating. Snohomish material? Possible lateral ejecta.	Washed Sediment
						376	178	8:50	Attempt to poke sediment. Silty sand. Abundant wood fragments. Appear to be back on Phase 1 cap.	Washed Sediment
						394	186	9:08	Starry flounder.	Washed Sediment
						431	204	9:45	Sand, wood fragments and shell along with intact spiochaetopterus tubes at sediment-water interface.	Washed Sediment
						460	217	10:14	Attempt to poke sediment. Silty sand. Cap material.	Washed Sediment
						476	225	10:30	End of transect, being pulled backwards.	Washed Sediment
W7	0	10/30/2013 12:13	13:35	47.62126	122.50428	0	0	2:03	At sediment surface.	Indeterminate
						0	0	2:16	Push into sediment. Very silty sand with some organic fragments at sediment surface that are partially covered with fine grained sediment. Cap or unresuspended sediment.	Indeterminate
						72	42	3:28	Appears to be silty sand with abundant infaunal burrows throughout sediment surface. Scattered wood/algae fragments.	Phase 1 Cap
						104	61	4:00	Silty sand/cap material.	Phase 1 Cap
						135	79	4:31	Silty sand/cap material large metridium at approximately 4:15.	Phase 1 Cap

Table 2-1. Observations from ROV Video Survey, October 30-31, 2013

Transect	Heading (Degrees Magnetic)	Start Date and Time	Video Duration	Latitude	Longitude	Travel time	Distance along transect (feet)	Elapsed Time	Feature Observation Notes	Interpretation
						176	103	5:12	Silty sand with scattered algae and wood fragments. Cap material. Abundant infaunal burrows.	Phase 1 Cap
						190	111	5:26	Approaching area that is more washed with bottle and wood fragments	Washed Phase 1 Cap
						195	114	5:31	Attempt to push into sediment, appears to be silty sand/cap material.	Washed Phase 1 Cap
						230	135	6:06	Numerous bivalves	Washed Phase 1 Cap
						250	146	6:26	Linear strings/accumulations of small wood fragments. Resuspension/transport to congregate woody fragments. Cap material.	Washed, wood stringers
						280	164	7:06	Continued wood accumulations over silty sand. Bivalve siphon.	Washed, wood stringers
						321	188	7:47	Slightly rippled silty sand with scattered accumulations of wood fragments. Algae and fines content increasing relative to 5:30-6:30	Washed Phase 1 Cap
						362	212	8:28	Silty sand with burrows and sea pens. Cap material and away from zone of resuspension.	Phase 1 Cap
						384	225	8:50	End of transect, being pulled backwards.	Phase 1 Cap
W11	190	10/30/2013 12:47	11:36	47.62102	122.50510	0	0	4:12	At sediment surface.	Phase 1 Cap
						0	0	4:15	Silty sand with scattered organic fragment sand shells. Appears to be cap material.	Phase 1 Cap
						45	33	5:00	Silty sand with abundant burrows at sediment surface. Appears to be cap material. High rate of travel.	Phase 1 Cap
						58	42	5:13	Attempt to push into sediment. Silty sand. Appears to be cap material.	Phase 1 Cap
						105	76	6:00	High altitude. Cannot make out features.	Indeterminate
						125	91	6:20	Slightly rippled silty sand with scattered accumulations of wood fragments. Some shell fragments.	Washed Phase 1 Cap
						157	114	6:52	Silty sand with detritally mantled wood fragments.	Washed Phase 1 Cap
						231	168	8:06	Attempt to strike seafloor. Silty sandy with cloud of fines kicked up.	Washed Phase 1 Cap
						267	194	8:40	Silty sand. Cap material.	Washed Phase 1 Cap
						297	216	9:10	Attempt to penetrate sediment. Silty sand appears to be cap material. Log/wood fragment.	Washed Phase 1 Cap
						309	225	9:22	End of transect, being pulled backwards.	Washed Phase 1 Cap
J9b	45	10/30/2013 13:31	21:21	47.61842	122.50365	0	0	4:20	At sediment surface.	Native
						0	0	4:20	Old piles from former west dock. Algae sand. No cap.	Native
						17	5	4:37	Substrate is gravelly sand with abundant barnacle fragments, thick and patchy coating of ulva.	Native
						75	21	5:35	Piles and ulva.	Native
						100	28	6:00	Parastichopus.	Native
						122	34	6:22	West dock piles.	Native
						175	49	7:15	Ulva and piles.	Native
						220	61	8:00	Ulva and piles.	Native
						280	78	9:00	100% ulva cover.	Native
						340	94	10:00	Ulva, barnacle fragment rich sand, no cap.	Native
						400	111	11:00	100% ulva cover.	Native
						460	128	12:00	100% ulva cover and beggiatoa on some decaying ulva.	Native

Table 2-1. Observations from ROV Video Survey, October 30-31, 2013

Transect	Heading (Degrees Magnetic)	Start Date and Time	Video Duration	Latitude	Longitude	Travel time	Distance along transect (feet)	Elapsed Time	Feature Observation Notes	Interpretation
						520	144	13:00	100% ulva cover and beggiatoa on some decaying ulva, some burrows and sediment exhumed is fringed with beggiatoa. Appears no cap.	Native
						580	161	14:00	100% ulva cover.	Native
						640	178	15:00	>75% ulva cover. 15:10 attempt to penetrate sediment. Hard gravelly sand that is not cap material but glacial material material from subtidal spit.	Native
						720	200	16:00	>75% ulva cover. Non-cap sands.	Native
						780	217	17:00	100% algae cover.	Native
						799	222	17:19	Eel grass.	Native
						810	225	18:10	Coming to surface, end of transect.	Native
J9b (2)	225	10/30/2013 13:42	4:57	47.61844	122.50366	0	0	1:33	At sediment surface.	Native
						12	14	1:45	Rattail.	Native
						17	20	1:50	Poke sediment, firm, shelly, very silty sand that does not appear to be Phase 1 or Phase 2 cap material.	Native
						41	49	2:14	Beggiatoa on sediment surface.	Native
						93	112	3:06	Old tire, partially buried and has anemones.	Native
						116	140	3:29	Impact with seafloor. Sandy silt or silty and, does not appear to be cap material at sediment-water interface.	Native
						160	193	4:13	Beggiatoa on sediment surface to left.	Native
						187	225	4:40	Uniform sand silt with abundant large burrows. Cannot discern cap material but may be buried under blanket of silt.	Native
J9 Edge	Variable	10/13/2013 14:20	15:05	47.61784	122.50388	0	0	1:03	At sediment surface.	Phase 2/3 Cap
						0	0	1:03	Gravelly sand. Appear to be Phase II cap material (Steilacoom gravels/fish mix).	Phase 2/3 Cap
						48	16	1:51	Moving off of cap material into sandy, shelly silt. Gradational contact between cap and native.	Native
						71	23	2:14	Attempting to push into sediment. Algae encrusted, sandy silt. Does not appear to be cap material.	Native
						195	64	4:18	Burrowed sandy silt with scattered ulva.	Native
						195	64	4:18	Old I-beam. No cap material. Abundant large burrows.	Native
						327	107	6:30	100% cover by brown benthic macroalgae with some large burrows.	Native
						366	120	7:09	Shelly sand with dense ulva covering. Fish mix gravel when ROV contacts bottom.	Native
						455	149	8:38	Transition from native to cap, some beggiatoa at sediment surface unrelated to decaying ulva.	Phase 2/3 Cap
						468	153	8:51	Cut piles from the former west dock.	Native
						485	159	9:08	Ulva and native sediment.	Native
						555	182	10:18	Crab.	Native
						582	191	10:45	Ulva and shelly native sand.	Native
						627	206	11:30	Ulva and pile from former west dock, native.	Native
						661	217	12:04	ROV contacting seafloor, native sediment.	Native
						686	225	12:29	End of transect, being pulled backwards.	Native
W10	90	10/30/2013 14:53	12:58	47.62196	122.50529	0	0	1:00	Removed magenta filter.	
						0	0	5:27	At sediment surface.	Lag/Native

Table 2-1. Observations from ROV Video Survey, October 30-31, 2013

Transect	Heading (Degrees Magnetic)	Start Date and Time	Video Duration	Latitude	Longitude	Travel time	Distance along transect (feet)	Elapsed Time	Feature Observation Notes	Interpretation
						0	0	5:27	Washed gravel/cobble and shell fragments over slightly silty sand. In zone of resuspension/transport. Possible native substrate.	Lag/Native
						0	0	5:45	Contact seafloor, very silty sand with cloud generated.	Lag/Native
						34	33	6:19	Still same substrate with scattered washed shells and gravels.	Lag/Native
						60	58	6:45	transitioning into silty sand that appears to be cap material. Video quality poor. Rapid transiting over seafloor.	Washed Phase 1 Cap
						94	91	7:19	Silty sand that appear to be cap material.	Washed Phase 1 Cap
						214	208	9:09	Silty sand with scattered shell, wood and algal fragments that appears to be Phase I cap material.	Washed Phase 1 Cap
						232	225	9:27	End of transect, being pulled backwards.	Washed Phase 1 Cap
W9	135	10/31/2013 10:22	10:24	47.62224	122.50473	0	0	1:16	At sediment surface.	Phase 1 Cap
						0	0	2:05	Hovering at drop point, appears to be silty sand with scattered wood fragments and shell fragments at the sediment-water interface. Abundant but not dense burrows and appears to be periodically washed based on the non-uniform draping of detritus on large surficial particles/debris.	Phase 1 Cap
						0	0	2:20	Start motion along transect, sediment surface remaining the same.	Phase 1 Cap
						6	0	2:26	Contact with the seafloor, appears to well sorted medium sand, little fines are stirred up when manipulator arm is inserted into the sediment.	Phase 1 Cap
						33	20	2:53	Moving into scattered wood debris field that appears to be subject to periodic resuspension.	Washed Phase 1 Cap
						47	29	3:07	Wood fragments and scattered cobble. Resuspension. Nudibranch at left.	Washed Phase 1 Cap
						67	41	3:27	Still in wood debris/stringer field.	Washed Phase 1 Cap
						78	48	3:38	100% wood debris cover.	Washed Phase 1 Cap
						110	68	4:10	Wood debris field with some detritus on woody debris.	Washed Phase 1 Cap
						145	89	4:45	On edge of wood debris field. Contact with sediment and manipulator arm divot suggests surface sediment is slightly silty medium sand.	Washed Phase 1 Cap
						170	105	5:10	Silty sand with minor surface relief and abundant burrows, appears to be Phase 1 cap material.	Phase 1 Cap
						189	117	5:29	Puncturing sediment, light turned on. Slightly silty sand.	Washed Phase 1 Cap
						220	136	6:00	Wood debris accumulation, sediment washed.	Washed Phase 1 Cap
						260	160	6:40	Wood debris and washed/resuspended sediment.	Washed Phase 1 Cap
						280	173	7:00	Poke sediment, appears to slightly silty sand.	Phase 1 Cap
						310	191	7:30	Back into burrowed silty sand without washed wood debris.	Phase 1 Cap
						335	207	7:55	Silty sand with scattered broken shell fragments, algae and burrows in sediment. Appear to be Phase 1 cap material.	Phase 1 Cap
						345	213	8:05	Poke of sediment and it appears sediment is firm silty sand.	Phase 1 Cap
						365	225	8:25	End of transect, being pulled backwards.	Phase 1 Cap

Table 2-1. Observations from ROV Video Survey, October 30-31, 2013

Transect	Heading (Degrees Magnetic)	Start Date and Time	Video Duration	Latitude	Longitude	Travel time	Distance along transect (feet)	Elapsed Time	Feature Observation Notes	Interpretation
W13	30	10/31/2013 10:55	17:29	47.62135	122.50665	0	0	1:20	At sediment surface.	Lag/Native
						0	0	1:20	Gravel and shell fragments, washed, not cap material and erosional lag.	Lag/Native
						0	0	1:50	Start moving along transect.	Lag/Native
						32	10	2:22	Remain on gravel lag, parastichopus.	Lag/Native
						68	21	2:58	Poke sediment, gravel over hard silty sand. Does not appear to be cap material. Bivalve siphon.	Lag/Native
						145	46	4:15	Gravel and shell lag, just starting to transition to some sand cover.	Lag/Native
						169	53	4:39	Poke sediment, medium sand with minor silt and scattered gravel. Wash area.	Lag/Native
						179	56	4:49	Start of shell hash field with scattered gravels over sand. Washed.	Lag/Native
						200	63	5:10	Poke sediment, sandy gravel, not cap material. In shell field.	Lag/Native
						245	77	5:55	Shell/gravel lag field and sand substrate.	Lag/Native
						390	123	8:20		Lag/Native
									Transitioning off of lag field, still hard packed trace silty sand.	Lag/Native
						466	147	9:36		
						488	154	9:58	Sand and lag (shell gravel) possibly native silts.	Washed Phase 1 Cap
						511	161	10:21	Poking sediment, slightly silty sand. Unclear whether reworked native or cap.	Washed Phase 1 Cap
						523	165	10:33	Section of plowed sediment shows a 2-5 cm thick sand layer of silt/clay that is presumably native.	Washed Phase 1 Cap
						620	196	12:10	Wood debris zone, washed, with some shell fragments.	Washed Phase 1 Cap
						674	213	13:06	Poke of sediment, slightly silty sand with scattered wood and algal debris at sediment-water interface.	Washed Phase 1 Cap
						700	221	13:32	Poke of sediment, slightly silty sand with scattered wood and algal debris at sediment-water interface.	Washed Phase 1 Cap
						713	225	13:45	End of transect.	Washed Phase 1 Cap
J10	45	10/31/2013 11:26	17:16	47.61753	122.50331	0	0	1:12	At sediment surface.	Native
						0	0	1:12	100% algae cover.	Native
						0	0	2:16	brown benthic macroalgae, poke sediment, detritus and silt/clay stirred up. Not cap material.	Native
						55	16	3:11	Benthic macroalgae, some ulva, beggiatoa at 3:34.	Native
						211	61	5:47	Poke sediment, some fine gravel under ulva cover, possible start or transition of Phase 2 cap material.	Phase 2/3 Cap
						261	75	6:47	Phase II cap material under ulva.	Phase 2/3 Cap
						299	86	7:23	Phase II cap material under ulva.	Phase 2/3 Cap
						335	97	7:59	Moving upslope into some cobbles, possible transition to native.	Phase 2/3 Cap
						349	101	8:13	At water surface.	
						410	118	9:14	Cut piles from former west dock, ROV turned and paralleled beach after surfacing. Nice transition from cap to native sand and gradual transition.	Native
						456	131	10:00	In piles of former west dock, dense ulva and ulva detrital hash over shell rich native sediment amongst and adjacent to cut piles.	Phase 2/3 Cap
						781	225	15:25	End of transect, being pulled backwards.	Phase 2/3 Cap

Table 2-1. Observations from ROV Video Survey, October 30-31, 2013

Transect	Heading (Degrees Magnetic)	Start Date and Time	Video Duration	Latitude	Longitude	Travel time	Distance along transect (feet)	Elapsed Time	Feature Observation Notes	Interpretation
J10 2	120	11:43:06	16:20	47.61755	122.50333	0	0	1:15	At sediment surface.	Indeterminate
						0	0	1:20	Sediment covered in benthic macroalgae.	Indeterminate
						40	11	2:00	Poke sediment, stir up detritus.	Indeterminate
						150	42	3:50	Poke sediment, stir up detritus.	Indeterminate
						176	50	4:16	Beggiatoa on decaying algae.	Indeterminate
						204	57	4:44	Poke sediment, 100% ulva.	Indeterminate
						250	70	5:30	100% ulva.	Indeterminate
						295	83	6:15	100% ulva with beggiatoa. From 6:15-8:10 is similar but more leaves start appearing around 7:15 and appears to be a quiescent settling area for vegetative/algal flotsam.	Indeterminate
						410	115	8:10	Transitioning into pebbly sediment that still has thick covering of ulva and leaf litter. Phase 2 cap.	Phase 2/3 Cap
						425	120	8:25	Phase 2 cap material under ulva.	Phase 2/3 Cap
						460	129	9:00	Phase 2 cap material with shell fragments, very shallow/intertidal.	Phase 2/3 Cap
						580	163	11:00	Phase 2 cap material with shell fragments, very shallow/intertidal.	Phase 2/3 Cap
						610	172	11:30	Phase 2 cap with some fines over surface.	Phase 2/3 Cap
						635	179	11:55	Phase 2 cap littoral zone.	Phase 2/3 Cap
						670	188	12:30	Phase 2 cap that is sorted in bands within a littoral zone.	Phase 2/3 Cap
						800	225	14:40	End of transect, being pulled backwards.	Phase 2/3 Cap
W8	180	10/31/2013 12:11	11:49	47.62246	122.50382	0	0	1:16	At sediment surface.	Phase 1 Cap
						0	0	1:27	Appears to be silty sand with detrital mantle. Wood and shell fragments at sediment-water interface that are draped with sediment/detritus. Not washed. Appears to be Phase 1 cap material.	Phase 1 Cap
						0	0	1:50	ROV starts moving after hovering. Bivalve.	Phase 1 Cap
						10	5	2:00	Poke sediment, silt is stirred up.	Phase 1 Cap
						30	14	2:20	Poke sediment, silt is stirred up. Appears to be very silty sand.	Phase 1 Cap
						70	33	3:00	Sediment type appears similar to previous, minor wood fragments that have a partial sediment cover.	Phase 1 Cap
						89	42	3:19	Great shot of polychaete retracting into its tube. Wood debris increasing.	Phase 1 Cap
						100	47	3:30	Similar sediment type, numerous burrows, sea pen.	Phase 1 Cap
						117	55	3:47	Accumulation of detritus mantled wood debris. Debris seems to settle here.	Phase 1 Cap
						151	71	4:21	Silty sand with scattered detritus mantled wood debris and algae.	Phase 1 Cap
						161	75	4:31	Poke sediment, appears to be Phase 1 cap material with post placement deposition.	Phase 1 Cap
						209	98	5:19	Poke sediment, appears to be Phase 1 cap material with post placement deposition.	Phase 1 Cap
						250	117	6:00	Poke sediment, appears to be Phase 1 cap material with post placement deposition. Some woody debris at surface that has both detrital and epizoan/epiphytic coating.	Phase 1 Cap

Table 2-1. Observations from ROV Video Survey, October 30-31, 2013

Transect	Heading (Degrees Magnetic)	Start Date and Time	Video Duration	Latitude	Longitude	Travel time	Distance along transect (feet)	Elapsed Time	Feature Observation Notes	Interpretation
						277	130	6:27	Poke sediment, slightly silty sand. Not as fine as previous parts of transect.	Washed Phase 1 Cap
						316	148	7:06	Bivalve, sed type same as 6:27.	Washed Phase 1 Cap
						350	164	7:40	Appears to be sand ripple in field of silty sand.	Washed Phase 1 Cap
						400	188	8:30	Cluster of bivalves, shells at sediment-water interface are free of detritus starting at 07:50.	Washed Phase 1 Cap
						430	202	9:00	Poking sediment, slightly silty sand. Appears to be silt under sand.	Washed Phase 1 Cap
						480	225	9:50	End of transect, being pulled backwards.	Washed Phase 1 Cap
W10	270	10/31/2013 12:47	9:11	47.62174	122.50513	0	0	1:24	At sediment surface.	Transport/Lag
						0	0	2:00	Poking sediment, appears to silty sand with some patches of coarser sand. Minor cobble and shell debris. Possibly washed/eroded.	Transport/Lag
						15	12	2:15	Wood fragments and shell that are washed.	Transport/Lag
						45	35	2:45	Appears to be silty sand with washed surface. No detritus on shell fragments. Unclear if cap material or thickness of sand.	Transport/Lag
						60	47	3:00	Poke sediment and it is firm to hard slightly silty sand. Very little penetration of manipulator arm.	Transport/Lag
						86	67	3:26	Wood debris accumulation in area of washing or sediment transport/resuspension. Unclear if cap material.	Transport/Lag
						105	81	3:45	Probe sediment, top 1 cm or so appears to be slightly silty sand that is firm. Surface shows evidence of washing.	Transport/Lag
						145	113	4:25	Woody debris, resuspension zone.	Transport/Lag
						202	157	5:22	Probe sediment, hard sand veneer with minor silt. Surface appears washed.	Transport/Lag
						225	175	5:45	Water column is becoming murky.	Transport/Lag
							0		Possible that outside of wood debris, there is native sediment.	Transport/Lag
						267	207	6:27	Probe sediment, hard sand veneer with minor silt. Surface appears washed.	Transport/Lag
						290	225	6:50	Wood debris accumulation and end of transect.	Transport/Lag
W6	180	10/31/2013 13:03	8:22	47.62203	122.50316	0	0	1:10	At sediment surface.	Phase 1 Cap
						0	0	1:45	Probe sediment and sediment appears to be very silty sand with dense cloud stirred up. Appears to be Phase 1 cap and post-placement deposition.	Phase 1 Cap
						40	31	2:25	Appears to be Phase 1 cap with silt/detrital mantling. Some woody debris can be seen in outline.	Phase 1 Cap
						66	50	2:51	Woody debris accumulation that is not completely mantled with detritus. Resuspension area.	Phase 1 Cap
						84	64	3:09	Sediment probe, firm silty sand. Phase 1 cap material likely	Washed Phase 1 Cap
						125	95	3:50	Sediment probe, firm silty sand. Phase 1 cap material likely.	Washed Phase 1 Cap
						185	141	4:50	Sediment surface from 02:51 onward has distinct woody debris that although not aggregated is free of detritus suggesting periodic resuspension.	Washed Phase 1 Cap

Table 2-1. Observations from ROV Video Survey, October 30-31, 2013

Transect	Heading (Degrees Magnetic)	Start Date and Time	Video Duration	Latitude	Longitude	Travel time	Distance along transect (feet)	Elapsed Time	Feature Observation Notes	Interpretation
						246	188	5:51	Dense accumulation of woody debris.	Washed Phase 1 Cap
						283	216	6:28	Probe sediment, appears to be silty sand and Phase 1 cap material. Somme detritus at sediment-water interface.	Phase 1 Cap
						295	225	6:40	End of transect, being pulled backwards.	Phase 1 Cap
W4	180	10/31/2013 13:29	10:44	47.62189	122.50243	0	0	1:58	At sediment surface.	Phase 1 Cap
						0	0	2:33	Probe sediment, very silty sand. Phase 1 cap.	Phase 1 Cap
						47	30	3:20	Phase 1 cap.	Phase 1 Cap
						59	38	3:32	Probe sediment, very silty sand. Phase 1 cap.	Phase 1 Cap
						139	90	4:52	Probe sediment, firmer, slightly silty sand. Some shell and wood fragments at surface that are only partially covered with sediment, possible start of wash zone.	Phase 1 Cap
						187	121	5:40	Patches of wood fragments and sabellid or onuphid tubes, resuspension. Faint, low relief rippling.	Washed Phase 1 Cap
						207	134	6:00	Probe sediment, hard slightly silty sand.	Washed Phase 1 Cap
						267	173	7:00	Patches of wood fragments and sabellid or onuphid tubes, resuspension. Faint, low relief rippling.	Washed Phase 1 Cap
						315	204	7:48	Probe sediment, silty sand. Appears to be Phase 1 cap.	Phase 1 Cap
						347	225	8:20	End of transect, being pulled backwards.	Phase 1 Cap
W14	30	10/31/2013 13:54	15:35	47.62113	122.50561	0	0	7:17	At sediment surface.	Lag/Native
						0	0	7:40	Probe sediment, hard slightly silty medium sand with shell fragments at sediment-water interface. Does not appear to be Phase I cap material. Start motion on transect.	
						30	21	8:10	Start motion along transect, sediment surface remaining the same. Rapid rate of advancement.	Lag/Native
						65	46	8:45	Sediment type same as at 4:47, surface appears washed and fluting around shells and hard surfaces.	Lag/Native
						86	60	9:06	Ripple field.	Lag/Native
						116	82	9:36	Start motion along transect, sediment surface remaining the same. Rapid rate of advancement.	Lag/Native
						134	94	9:54	Probe sediment, hard slightly silty medium sand with shell fragments at sediment-water interface and sparse gravels at sediment-water interface. Does not appear to be Phase 1 cap material.	Lag/Native
						168	118	10:28	High altitude but multiple dark objects on seafloor interpreted to be lag gravels. Start lag deposit.	Lag/Native
						184	129	10:44	Probe sediment. Hard slightly silty sand with shell fragments and lag gravels at sediment-water interface. Not Phase 1 cap Material.	Lag/Native
						217	153	11:17	Wood fragments and shell that are washed.	Lag/Native
						260	183	12:00	Wood fragments, shell and barnacles encrusted bottles and can.	Lag/Native
						305	214	12:45	Transitioning into finer material.	Washed Phase 1 Cap?
						320	225	13:00	Probe sediment, very sandy silt, thick cloud generated. Wood and shell at sediment-water interface.	Washed Phase 1 Cap?
						320	225	13:00	End of transect, being pulled backwards.	Washed Phase 1 Cap?
W5	0	10/31/2013 14:20	10:02	47.62059	122.50346	0	0	1:25	At sediment surface.	Phase 1 Cap

Table 2-1. Observations from ROV Video Survey, October 30-31, 2013

Transect	Heading (Degrees Magnetic)	Start Date and Time	Video Duration	Latitude	Longitude	Travel time	Distance along transect (feet)	Elapsed Time	Feature Observation Notes	Interpretation
						0	0	1:50	Sediment surface appears to be silty sand with scattered shell fragments that have detritus mantling.	Phase 1 Cap
						0	0	1:51	Start moving along transect.	Phase 1 Cap
						9	6	2:00	Probe sediment, firm slightly silt sand.	Phase 1 Cap
						49	32	2:40	Several rocks that are exposed and have barnacle encrustations, appears to be cap material but washed slightly.	Phase 1 Cap
						69	44	3:00	Faint ripples, scattered wood debris, shells and rocks on distinct silty sand that is well burrowed by infauna.	Washed Phase 1 Cap
						99	64	3:30	Probe sediment, firm slightly silt sand.	Washed Phase 1 Cap
						144	93	4:15	Probe sediment, silty sand. Definitely Phase 1 cap material	Phase 1 Cap
						171	110	4:42	Wood fragment with rich detrital coating.	Phase 1 Cap
						212	137	5:23	Probe sediment, very silty sand. Phase I cap.	Phase 1 Cap
						224	144	5:35	Barnacle encrusted bottle, sediment probe very silty sand.	Phase 1 Cap
						319	206	7:10	Attempted sediment probe. Silty sand, Phase I cap material.	Phase 1 Cap
						339	219	7:30	Sediment probe. Silty sand, Phase I cap material.	Phase 1 Cap
						349	225	7:40	End of transect, being pulled backwards.	Phase 1 Cap

Notes:
ROV = remotely operated vehicle
Interpretation definitions:
Phase 1 Cap = material consistent with Phase 1 cap material observed at the sediment surface at this location.
Phase 1 Cap slight resuspension = material consistent with Phase 1 cap material observed at the sediment surface at this location, but shows evidence of slight resuspension of material.
Lag/Native = relatively coarse surface sediment at this location - possibly hydraulically winnowed of fines/ original Eagle Harbor sediment (no cap material evident).
Washed Sediment = evidence of hydraulic sorting.
Indeterminate = unable to determine cap presence or absence.
Washed Phase 1 Cap = surface sediment appears consistent with Phase 1 cap material but with evidence of some hydraulic sorting.
Washed, wood stringers = evidence of hydraulic sorting of sediment, including linear deposits of woody detritus.
Native = original Eagle Harbor sediment (no cap material evident).
Phase 2/3 Cap = material consistent with Phase 2/3 cap material observed at the sediment surface at this location.
Transport/Lag = surface sediment shows evidence of having been hydraulically transported or winnowed.

Table 2-2. Proposed Videocore Transect Station Locations

Transect Number	Station Number	Latitude	Longitude
T1	1	47.62091	-122.50722
	2	47.62112	-122.50715
	3	47.62159	-122.50699
	4	47.62200	-122.50685
	5	47.62224	-122.50676
	6	47.62243	-122.50670
T2	7	47.62251	-122.50582
	8	47.62225	-122.50587
	9	47.62202	-122.50592
	10	47.62161	-122.50599
	11	47.62142	-122.50603
	12	47.62124	-122.50606
	13	47.62100	-122.50610
T3	14	47.62120	-122.50522
	15	47.62138	-122.50518
	16	47.62155	-122.50515
	17	47.62215	-122.50502
	18	47.62253	-122.50493
T4	19	47.62222	-122.50421
	20	47.62197	-122.50426
	21	47.62163	-122.50434
	22	47.62145	-122.50438
T5	23	47.62122	-122.50350
	24	47.62146	-122.50347
	25	47.62170	-122.50344
	26	47.62192	-122.50341
	27	47.62213	-122.50339
T6	28	47.62171	-122.50268
	29	47.62140	-122.50273
T7	31	47.62177	-122.50188
	30	47.62148	-122.50190
T8	32	47.61748	-122.50306
	33	47.61753	-122.50338
	34	47.61757	-122.50370
	35	47.61761	-122.50399
T9	36	47.61783	-122.50390
	37	47.61782	-122.50375
	38	47.61779	-122.50344
	39	47.61776	-122.50310
T10	40	47.61828	-122.50411
	41	47.61825	-122.50373
	42	47.61822	-122.50339
T11	43	47.61856	-122.50333
	44	47.61858	-122.50363
	45	47.61860	-122.50399
T12	46	47.62252	-122.50754
	47	47.62228	-122.50761
	48	47.62154	-122.50782
	49	47.62132	-122.50789

Note: Videocore locations may be modified in the field.

Table 2-3. Proposed Vibracore Locations

Name	Longitude	Latitude
C1	-122.50722	47.62091
C2	-122.50363	47.61858
C3	-122.50582	47.62251
C4	-122.50434	47.62163
C5	-122.50373	47.61825
C6	-122.50344	47.61779

Note: Vibracore locations may be modified based on field observations.